B.S.

Evaluation of IR Countermeasures

AH-1G (Cobra) Model Report (U)

August 20, 1973

Prepared for

Program Manager
U.S. Army Aviation Systems Command
AMCPM-AEWSPS
Box 209, 12th and Spruce Street
St. Louis, Mo.   63166
Under Contract DAAJ01-72-0447, Exhibit A, Data   A003

by

Westinghouse Electric Corporation
Systems Developement Division
Strike Systems Avionics, M/S-434
Box 746, Baltimore, Md. 21203

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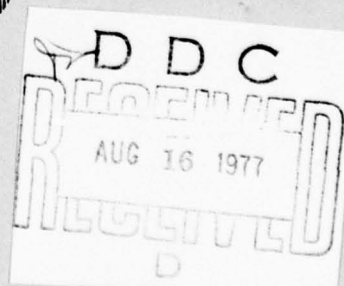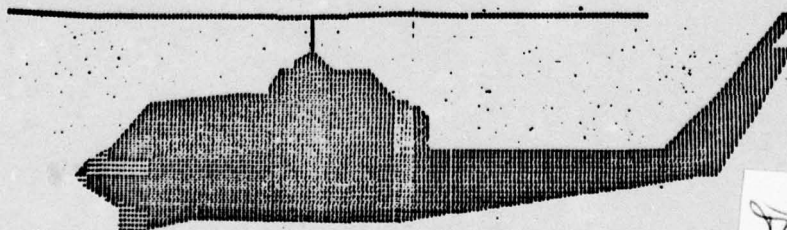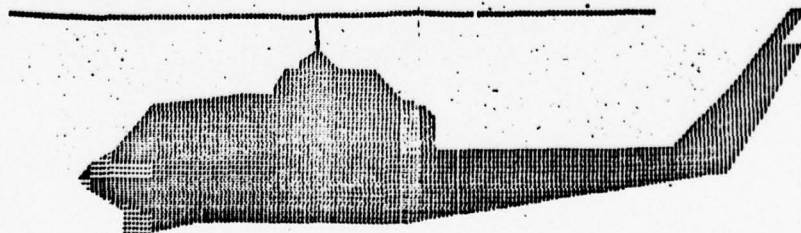Under Contract DAAJ01-72-0447, Exhibit A, Data   A003

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AH – 1G (COBRA)

1.0 (U) INTRODUCTION

The HIDE model is a comprehensive computer program designed to simulate the infrared signatures of Army aircraft.

The HIDE model was developed under contract DAA-J01-72-C-0447, "Evaluation of IR Countermeasures", for the U.S. Army Aviation Systems Command, AMCPM-AEWSPS. This work has been reported in two volumes:

Interim Technical Report (Model Methodology) 6-26-72

Final Technical Report (Phase II HIDE Model) 2-28-73

The original work developed the signature of a UH-1H helicopter. The work reported here is an extention to this contract to model an AH-1G helicopter to run in the HIDE model.

Section 2 defines the structural modeling refered to as Body data.

Section 3 describes the turbine and air frame operational models.

Section 4 presents a predicted signature after integration into the HIDE model.

Appendicies are included which contain program elements and reference data.

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2.0 (U) HELICOPTER BODY DATA

The AH-1G body was dissected into ninety-five (95) surfaces as shown in Table 2-1. The technique used was that described in Appendix A of the Phase II Final Report.[1] A breakdown of the helicopter by surface types shows:

> 67 flats including:
>
> > 28 rectangles (type 1),
> >
> > 12 discs   (type 2),
> >
> > 27 trapesoids (type 3), and
>
> 28 conics including:
>
> > 13 cylinders (type 4),
> >
> > 11 cones   (type 5),
> >
> > 4 spheres   (type 6), and
> >
> > 0 circular parabolids (type 7).

An isometric drawing of the helicopter showing how the helicopter was dissected is presented in figure 2-1. A numbered balloon for each surface indicates surface number and type. Dashed balloons are used for surfaces on the right side of the helicopter which are mirror images of left side surfaces. In each case the surface number for the right side surface is one higher than the surface number for the mirror image surface on the left side.

Two large computer printouts showing the helicopter from 70° and 170° aspect angles off the nose are shown in figures 2-2 and 2-3.

The numbers on the helicopter represent the surface number. Certain areas such as the canopy, right wing, and horizontal stabilizer are outlined for clarity. In figure 2-4, the front, top and side views from a computer

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[1] Evaluation of Countermeasures, Phase II Hide Model Final Technical Report by Westinghouse Electric Corporation, February 28, 1972 (Secret)

Table 2-1. AH-1G Helicopter Geometrical Structure Data

SURFACE NUMBER	HELICOPTER PART DESCRIPTION	SURFACE TYPE	FLIGHT STATION	WATER-LINE	BULKHEAD LINE	ALPHA
1	NOSE BUBBLE	SPHERE	-36.010	54.000	.000	8.000
2	NOSE BUBBLE BASE	RECTANGLE	-36.000	54.000	.000	.000
3	TOP NOSE	TRAPESOID	1.600	44.850	.000	.000
4	BOTTOM NOSE	TRAPESOID	1.550	57.500	.000	.000
5	TOP FRONT L. SIDE	TRAPESOID	-18.500	54.000	4.280	.000
6	TOP FRONT R. SIDE	TRAPESOID	-18.500	54.000	-4.280	.000
7	FRONT L. SIDE	RECTANGLE	-83.000	64.000	18.000	.000
8	FRONT R. SIDE	RECTANGLE	-83.000	64.000	-18.000	.000
9	TURRET	CYLINDER	-71.250	21.620	.000	10.000
10	TURRET BASE	DISC	-71.250	21.620	.000	.000
11	LOWER FRONT L. SIDE	TRAPESOID	-9.900	54.010	2.450	.000
12	LOWER FRONT R. SIDE	TRAPESOID	-9.900	54.010	-2.450	.000
13	L. SIDE	TRAPESOID	31.510	54.000	18.000	.000
14	R. SIDE	TRAPESOID	31.510	54.000	-18.000	.000
15	LOWER L. SIDE	RECTANGLE	-82.990	54.010	18.000	.000
16	LOWER R. SIDE	RECTANGLE	-82.990	54.010	-18.000	.000
17	BACK OF NOSE	RECTANGLE	-53.500	70.000	-11.720	.000
18	FRONT OVERHEAD CANOPY	RECTANGLE	-53.490	69.990	.000	.000
19	CURVED L. FRONT CANOPY	CONE	-36.000	53.200	8.000	8.750
20	CURVED R. FRONT CANOPY	CONE	-36.000	53.200	-8.000	8.750
21	LOWER L. FRONT CANOPY	TRAPESOID	-50.370	64.000	11.060	.000
22	LOWER R. FRONT CANOPY	TRAPESOID	-50.370	64.000	-11.060	.000
23	REAR OVERHEAD CANOPY	RECTANGLE	-82.990	98.300	.000	.000
24	REAR L. CURVED CANOPY	CYLINDER	-167.875	95.725	8.000	10.000
25	REAR R. CURVED CANOPY	CYLINDER	-167.875	95.725	-8.000	10.000

Table 2-1. AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	BETA-MIN	BETA-MAX	GAMMA-MIN	GAMMA-MAX	PSI	THETA	PHI
1	.000	90.000	.001	360.000	.000	90.000	.000
2	-8.000	8.000	-8.000	8.000	.000	90.000	.000
3	-60.650	-41.400	169.040	190.960	-90.000	.000	-24.550
4	-88.500	-39.300	168.500	191.500	-90.000	.000	17.030
5	-35.800	-17.900	155.900	180.000	-102.000	-90.000	.000
6	-17.900	35.800	.000	24.100	102.000	-90.000	.000
7	.000	10.000	.000	30.030	-12.000	.000	-90.000
8	.000	10.000	.000	30.030	12.000	.000	-90.000
9	.000	25.000	.001	360.000	.000	.000	.000
10	.000	10.000	.001	360.000	.000	.000	.000
11	26.670	74.670	.000	16.700	78.000	90.000	.000
12	-74.670	-26.670	163.300	180.000	-78.000	90.000	.000
13	-198.840	-114.500	174.900	180.000	-90.000	-90.000	.000
14	114.500	198.840	.000	5.100	90.000	-90.000	.000
15	.000	84.340	.000	27.010	90.000	90.000	.000
16	-84.340	.000	.000	27.010	-90.000	90.000	.000
17	.000	23.440	.000	16.000	.000	90.000	.000
18	-8.000	8.000	-40.900	.000	.000	43.800	.000
19	15.000	64.100	.001	360.000	.000	-54.950	.000
20	15.000	64.100	.001	360.000	.000	-54.950	.000
21	-35.600	-5.570	143.700	180.000	-102.000	-90.000	.000
22	5.570	35.600	.000	36.300	102.000	-90.000	.000
23	-8.000	8.000	-54.900	.000	.000	5.100	.000
24	.000	84.500	.001	360.000	.000	95.100	.000
25	.000	84.500	.001	360.000	.000	95.100	.000

Table 2-1.   AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	HELICOPTER PART DESCRIPTION	SURFACE TYPE	FLIGHT STATION	WATER-LINE	BULKHEAD LINE	ALPHA
26	REAR L. CANOPY	RECTANGLE	-83.000	64.000	18.000	.000
27	REAR R. CANOPY	RECTANGLE	-83.000	64.000	-18.000	.000
28	SOLID OVERHEAD	RECTANGLE	-167.330	105.675	.000	.000
29	L. MID SIDE	RECTANGLE	-251.000	68.000	18.000	.000
30	R. MID SIDE	RECTANGLE	-251.000	68.000	-18.000	.000
31	L. MID TOP	CONE	-251.000	95.675	8.000	6.820
32	R. MID TOP	CONE	-251.000	95.675	-8.000	6.820
33	MID TOP	RECTANGLE	-200.000	105.675	.000	.000
34	L.SIDE TAIL BOOM	TRAPESOID	-586.170	68.000	.500	.000
35	R.SIDE TAIL BOOM	TRAPESOID	-586.170	68.000	-.500	.000
36	BOTTOM TAIL BOOM	TRAPESOID	-596.000	69.203	.000	.000
37	L. FRONT TOP ENG COWLING	CONE	-197.000	95.000	18.000	3.000
38	R. FRONT TOP ENG COWLING	CONE	-197.000	95.000	-18.000	3.000
39	L. FRONT BOT ENG COWLING	CONE	-197.000	76.800	18.000	3.000
40	R. FRONT BOT ENG COWLING	CONE	-197.000	76.800	-18.000	3.000
41	DRIVE SHAFT HOUSING	CYLINDER	-485.670	68.000	.000	5.000
42	DRIVE SHAFT HOUSING CAP	SPHERE	-485.670	68.000	.000	5.000
43	REAR TAIL BOOM	RECTANGLE	-485.670	68.000	.000	.000
44	VERTICAL STABILIZER	TRAPESOID	-597.470	183.800	.000	.000
45	TAIL ROTOR HUB	CYLINDER	-520.670	119.650	.000	1.000
46	TAIL ROTOR	RECTANGLE	-520.670	119.650	14.750	.000
47	HORIZONTAL STABILIZER	RECTANGLE	-397.000	56.330	.000	.000
48	BOTTOM	RECTANGLE	-251.000	27.000	.000	.000
49	L. SIDE BEHIND TURRET	TRAPESOID	-117.400	27.000	10.000	.000
50	R. SIDE BEHIND TURRET	TRAPESOID	-117.400	27.000	-10.000	.000

Table 2-1.   AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	BETA- MIN	BETA- MAX	GAMMA- MIN	GAMMA- MAX	PSI	THETA	PHI
26	-24.450	.000	-87.500	.000	.000	5.100	-90.000
27	.000	24.450	-87.500	.000	.000	5.100	90.000
28	-8.000	8.000	.000	25.350	.000	5.100	.000
29	.000	41.000	.000	83.670	.000	.000	-90.000
30	-41.000	.000	.000	83.670	.000	.000	90.000
31	.000	83.670	.001	360.000	.000	90.000	.000
32	.000	83.670	.001	360.000	.000	90.000	.000
33	-8.000	8.000	.000	32.670	.000	.000	.000
34	-335.250	-100.500	173.020	180.000	90.000	90.000	-3.000
35	-335.250	-100.500	180.000	186.980	90.000	-90.000	-3.000
36	-347.830	-110.330	177.040	182.960	90.000	180.000	-6.980
37	.000	17.200	.001	360.000	.000	-90.000	.000
38	.000	17.200	.001	360.000	.000	-90.000	.000
39	.000	17.200	.001	360.000	.000	-90.000	.000
40	.000	17.200	.001	360.000	.000	-90.000	.000
41	.000	200.000	.001	360.000	.000	90.000	.000
42	.000	180.000	.001	360.000	.000	-90.000	.000
43	-5.750	5.750	.000	13.100	.000	90.000	.000
44	50.400	128.800	37.000	51.000	.000	.000	-90.000
45	.000	14.750	.001	360.000	.000	.000	-90.000
46	-4.625	4.625	-52.500	52.500	.000	-45.000	-90.000
47	-41.330	41.330	-21.400	.000	.000	.000	.000
48	-18.000	18.000	.000	168.000	.000	.000	.000
49	-34.400	.000	171.040	180.000	90.000	90.000	.000
50	.000	34.400	.000	8.960	-90.000	90.000	.000

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Table 2-1. AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	HELICOPTER PART DESCRIPTION	SURFACE TYPE	FLIGHT STATION	WATER-LINE	BULKHEAD LINE	ALPHA
51	BEHIND TURRET	RECTANGLE	-83.000	27.000	.000	.000
52	BOTTOM BEHIND TURRET	RECTANGLE	-117.400	27.000	.000	.000
53	ROTOR HUB	CYLINDER	-200.000	127.350	.000	1.000
54	ROTOR	RECTANGLE	-200.000	152.620	.000	.000
55	FWD. SECT. HORIZ. STAB.	TRAPESOID	-382.280	56.330	.000	.000
56	TOP WING	RECTANGLE	-215.720	58.690	.000	.000
57	BOTTOM WING	RECTANGLE	-215.720	58.690	.000	.000
58	L. FRONT WING TIP	DISC	-186.120	66.070	61.940	.000
59	R. FRONT WING TIP	DISC	-186.120	66.070	-61.940	.000
60	L. REAR WING TIP	DISC	-215.720	58.690	61.940	.000
61	R. REAR WING TIP	DISC	-215.720	58.690	-61.940	.000
62	FRONT OF SAIL	CYLINDER	-183.130	105.675	.000	13.100
63	TOP FRONT OF SAIL	CONE	-193.350	120.800	.000	56.000
64	BACK OF TOP FRONT SAIL	RECTANGLE	-193.350	120.800	.000	.000
65	L. FRONT SAIL	TRAPESOID	-193.350	120.800	13.100	.000
66	R. FRONT SAIL	TRAPESOID	-193.350	120.800	-13.100	.000
67	L. REAR SAIL	TRAPESOID	-295.600	68.000	.000	.000
68	R. REAR SAIL	TRAPESOID	-295.600	68.000	.000	.000
69	L. MID AFT SAIL	TRAPESOID	-193.350	120.800	13.100	.000
70	R. MID AFT SAIL	TRAPESOID	-193.350	120.800	-13.100	.000
71	L. MID SAIL	TRAPESOID	-193.350	120.800	13.100	.000
72	R. MID SAIL	TRAPESOID	-193.350	120.800	-13.100	.000
73	FRONT TOP SAIL	DISC	-187.720	120.800	.000	.000
74	MID TOP SAIL	RECTANGLE	-205.720	120.800	.000	.000
75	AFT TOP SAIL	TRAPESOID	-245.720	120.800	.000	.000

Table 2-1. AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	BETA-MIN	BETA-MAX	GAMMA-MIN	GAMMA-MAX	PSI	THETA	PHI
51	-10.000	10.000	.000	5.380	.000	90.000	.000
52	-10.000	10.000	.000	34.810	.000	8.960	.000
53	.000	25.270	.001	360.000	.000	.000	.000
54	-13.000	13.000	-264.000	264.000	45.000	.000	.000
55	-14.720	.000	109.600	250.400	-90.000	.000	.000
56	-61.940	61.940	.000	30.300	.000	-14.000	.000
57	-61.940	61.940	.000	31.000	.000	-7.000	.000
58	.000	5.000	.001	360.000	.000	.000	-90.000
59	.000	5.000	.001	360.000	.000	.000	90.000
60	.000	30.500	95.000	113.000	.000	.000	-90.000
61	.000	30.500	67.000	85.000	.000	.000	90.000
62	-8.850	9.450	.001	360.000	.000	-34.000	.000
63	.000	8.850	.001	360.000	.000	146.000	.000
64	-13.100	13.100	.000	8.860	.000	56.000	.000
65	.000	18.000	.000	34.000	.000	.000	-90.000
66	-18.000	.000	146.000	180.000	.000	.000	90.000
67	-54.500	.000	118.063	136.876	14.832	.000	-75.644
68	.000	54.500	43.124	61.937	-14.832	.000	75.644
69	-54.500	.000	118.063	136.876	-165.168	.000	75.644
70	.000	54.500	43.124	61.937	165.168	.000	-75.644
71	-52.800	.000	135.000	180.000	180.000	.000	90.000
72	-52.800	.000	180.000	225.000	.000	.000	90.000
73	.000	14.000	.001	360.000	.000	.000	.000
74	-14.000	14.000	.000	18.000	.000	.000	.000
75	-40.000	.000	160.700	199.300	90.000	.000	.000

Table 2-1. AH-1G Helicopter Geometrical Structure Data (Cont'd)

| SURFACE NUMBER	HELICOPTER PART DESCRIPTION	SURFACE TYPE	FLIGHT STATION	WATER-LINE	BULKHEAD LINE	ALPHA
76	TOP OF ROTOR HUB COWLING	DISC	-200.000	127.350	.000	.000
77	ROTOR HUB COWLING	CONE	-200.000	152.620	.000	22.750
78	L. AFT SIDE	CYLINDER	-251.000	68.000	8.000	10.000
79	R. AFT SIDE	CYLINDER	-251.000	68.000	-8.000	10.000
80	L. REAR	SPHERE	-251.000	68.000	8.000	10.000
81	L. REAR	SPHERE	-251.000	68.000	-8.000	10.000
82	REAR ENGINE COWLING	CONE	-323.800	85.900	.000	15.510
83	REAR ENGINE	DISC	-285.400	85.900	.000	.000
84	TAIL PIPE	CYLINDER	-283.330	85.900	.000	8.023
85	TAIL PIPE INTERIOR	DISC	-283.330	85.900	.000	4.100
86	REAR ENGINE INTERNAL PL.	DISC	-264.900	85.900	.000	.000
87	L. MID ENGINE COWLING	CYLINDER	-263.400	85.900	.100	16.350
88	R. MID ENGINE COWLING	CYLINDER	-263.400	85.900	-.100	16.350
89	L. ENGINE INTAKE	DISC	-212.700	85.900	4.750	.000
90	R. ENGINE INTAKE	DISC	-212.700	85.900	-4.750	.000
91	TOP TAIL BOOM	TRAPESOID	-596.000	68.000	.000	.000
92	MID L. SIDE	RECTANGLE	-167.330	95.675	18.000	.000
93	MID R. SIDE	RECTANGLE	-167.330	95.675	-18.000	.000
94	LEADING EDGE WING	CYLINDER	-186.120	66.070	.000	3.750
95	FRONT FUSELAGE	RECTANGLE	-83.000	32.000	.000	.000

Table 2-1. AH-1G Helicopter Geometrical Structure Data (Cont'd)

SURFACE NUMBER	BETA-MIN	BETA-MAX	GAMMA-MIN	GAMMA-MAX	PSI	THETA	PHI
76	.000	10.650	.001	360.000	.000	.000	.000
77	25.270	32.000	.001	360.000	.000	180.000	.000
78	.000	83.670	.001	360.000	.000	90.000	.000
79	.000	83.670	.001	360.000	.000	90.000	.000
80	.001	180.000	.001	360.000	.000	.000	.000
81	.001	180.000	.001	360.000	.000	.000	.000
82	38.400	58.900	.001	360.000	.000	90.000	.000
83	.000	10.650	.001	360.000	.000	-90.000	.000
84	.000	4.100	.001	360.000	.000	-79.000	.000
85	.000	8.023	.001	360.000	.000	-79.000	.000
86	.000	16.350	.001	360.000	.000	-90.000	.000
87	.000	51.000	.001	360.000	5.250	90.000	.000
88	.000	51.000	.001	360.000	-5.250	90.000	.000
89	.000	16.350	.001	360.000	5.250	90.000	.000
90	.000	16.350	.001	360.000	-5.250	90.000	.000
91	-345.000	-110.330	177.000	183.000	90.000	.000	.000
92	.000	59.100	.000	27.625	90.000	90.000	-6.820
93	-59.100	.000	.000	27.625	-90.000	90.000	6.820
94	-61.940	61.940	.001	360.000	.000	.000	90.000
95	-18.000	18.000	.000	5.000	.000	90.000	.000
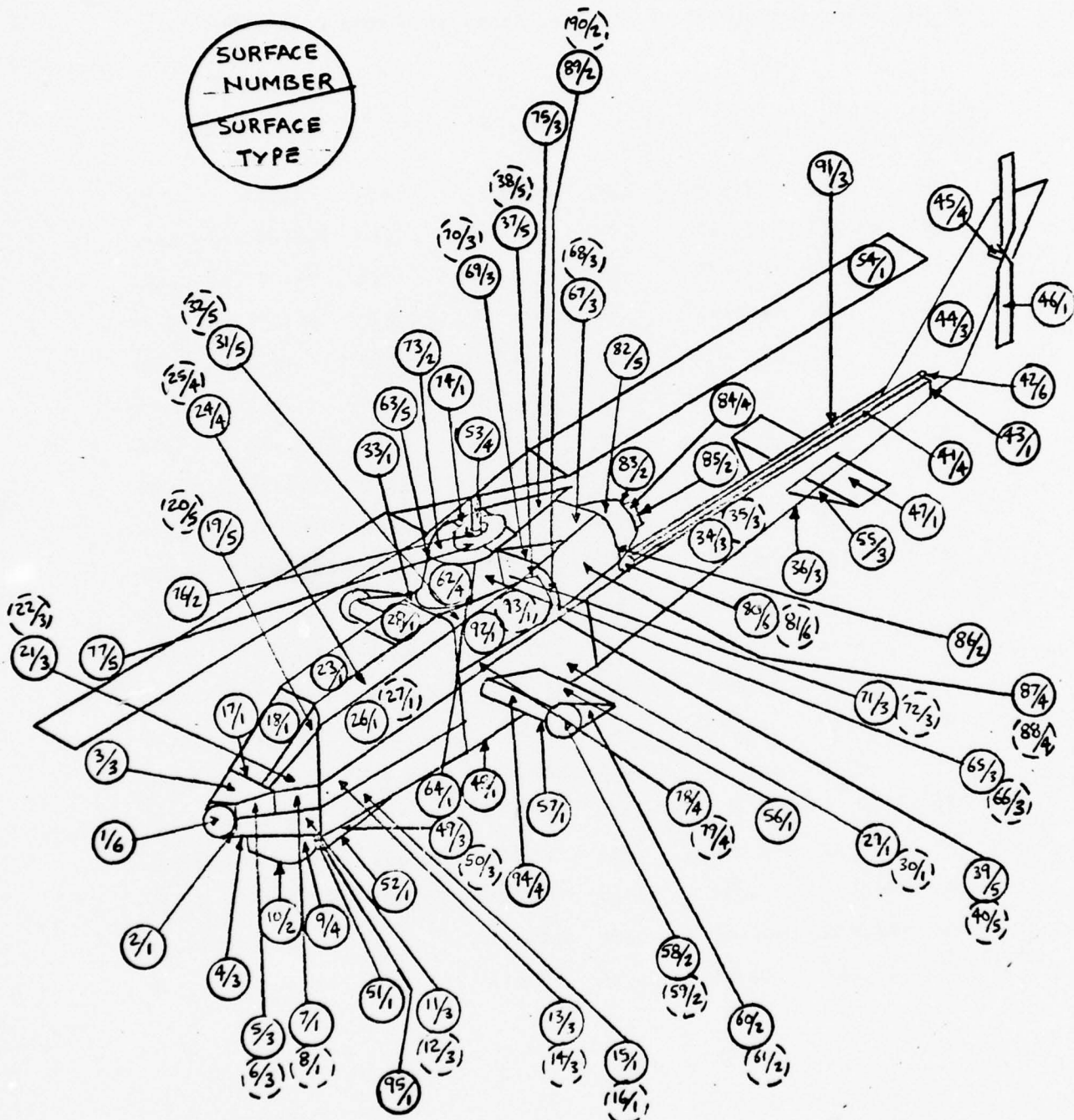
AH-1G COBRA

FIGURE 2-1 (U) AH-1G SURFACE LOCATION

2-10
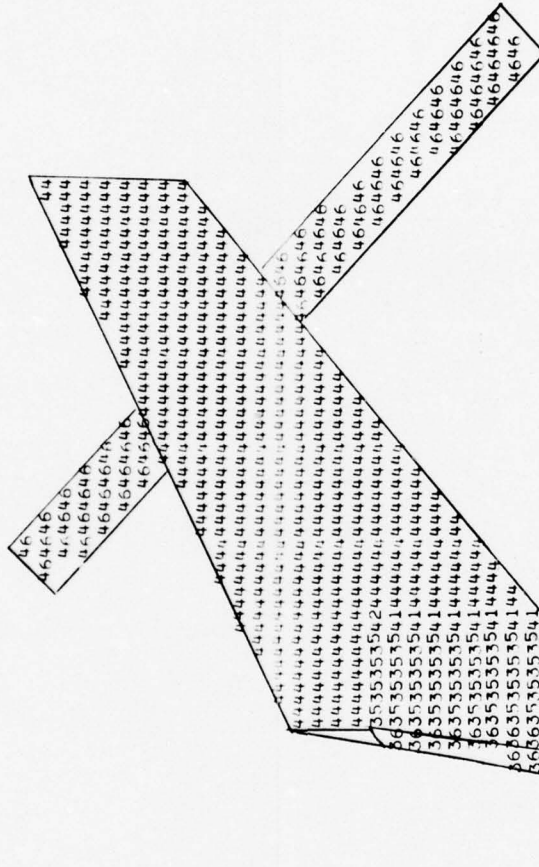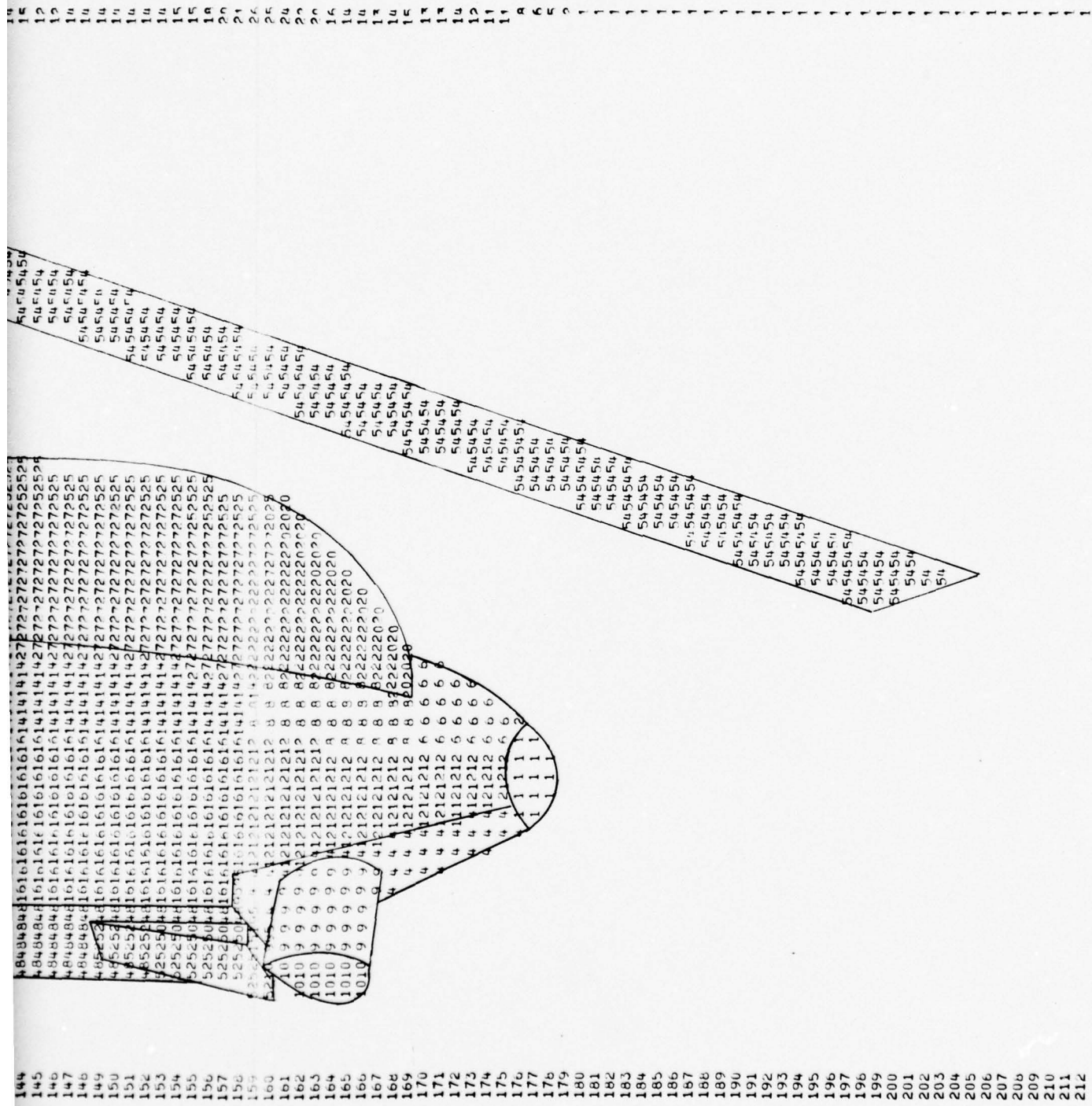
FIGURE 2-2. (U) AH-1G PRINTOUT @ 70$^{\text{O}}$ASPECT WITH 20$^{\text{O}}$
LEFT ROLL
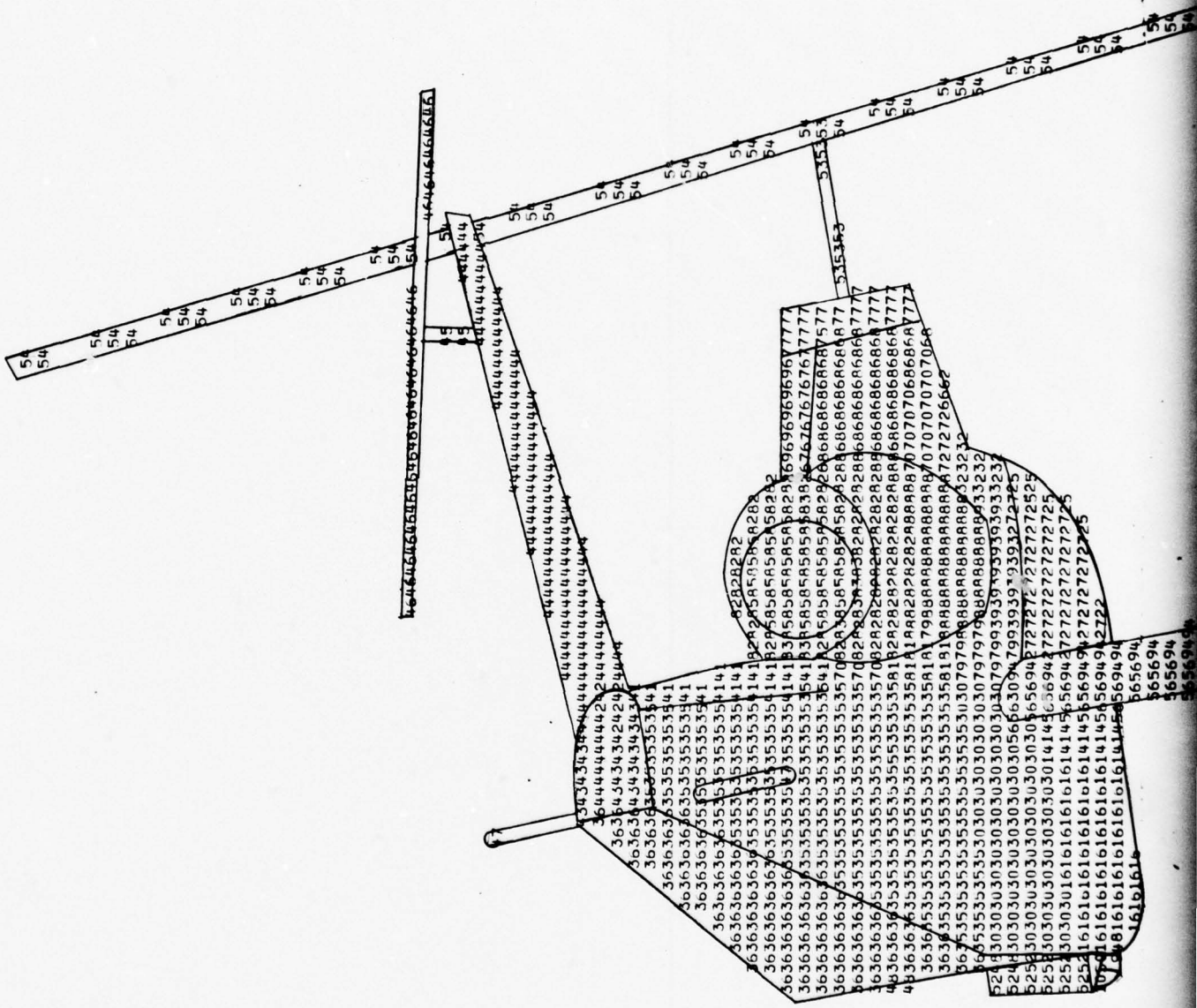
2-11/2-12

FIGURE 2-3. (U) AH-1G PRIN
10°

FIGURE 2-3. (U) AH-1G PRINTOUT @ 170° ASPECT WITH
10° DOWN PITCH

RHD-7

2-13/2-14
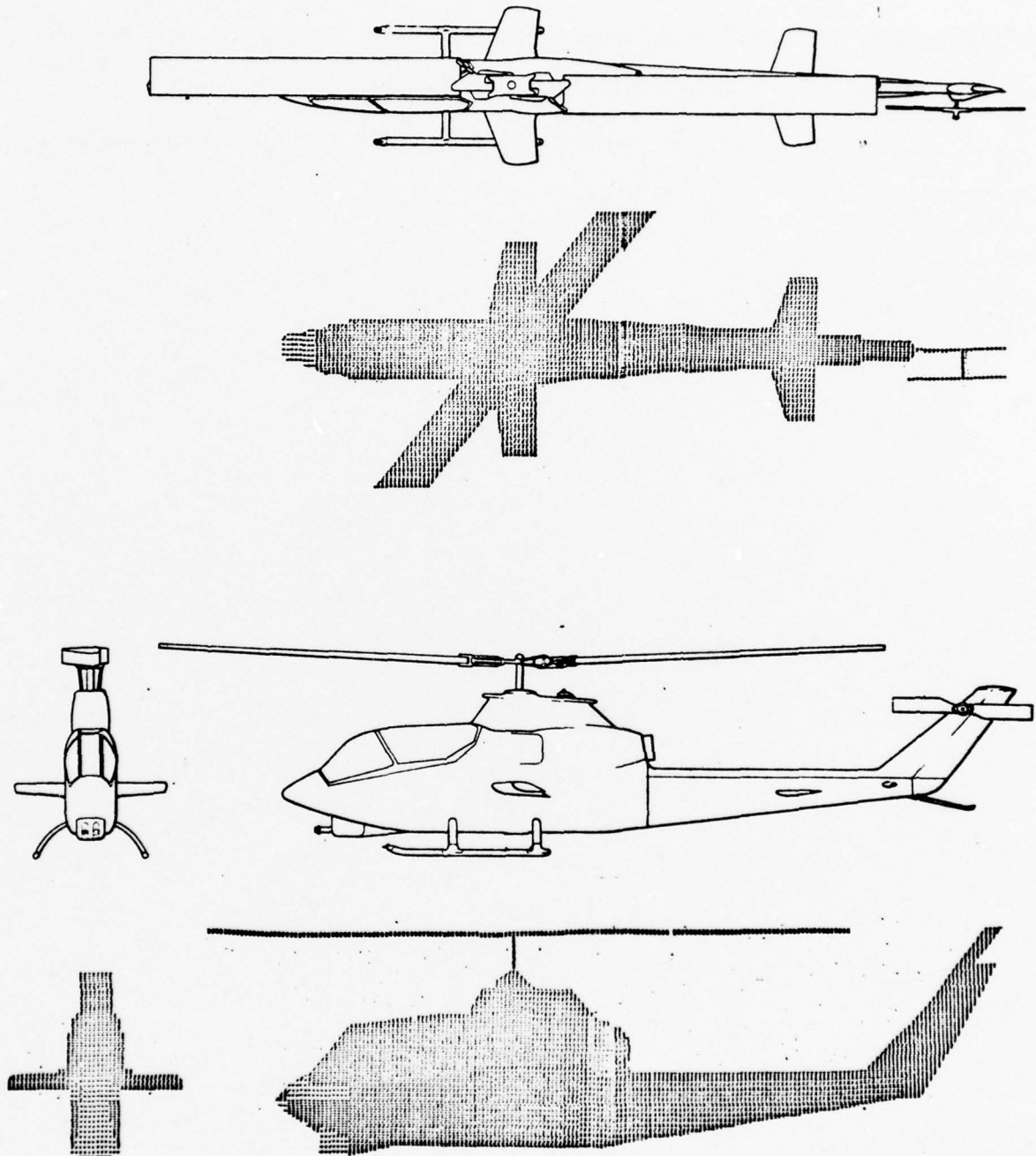
FIGURE 2-4. (U) AH-1G SILHOUETTE COMPARISONS

printout have been reduced in size to the scale of a three view drawing from a AH-1G manual. The individual numbers have become too small to read, but the silhouettes compare favorable with those of the three view drawing.

A listing of the body Block Data in the HIDE Model is presented in Appendix A.

3.0 (U) HELICOPTER OPERATING CHARACTERISTICS AND TURBINE DATA

The Hide Model requires certain data which describes the plume exit from the tailpipe. This data is computed in an off-line program using inputs which describe the helicopter operating characteristics and the turbine. The input data for the off-line program is presented in tabular form in this section. A listing of the off-line program and its block data are presented Appendix B.

3.1 (U) HELICOPTER OPERATING CHARACTERISTICS

The operating characteristics for the AH-1G helicopter are presented in tabular form in Tables 3-1 through 3-4. Table 3-1 presents speed and torque data as a function of pressure altitude for long range cruise speed. Tables 3-2, 3-3 and 3-4 present similar data for long range intermediate cruise speed, long range maximum speed, and maximum endurance flight, respectively.

The original data from the AH-1G Operator's Manual from which Tables 3-1 to 3-4 were generated are shown in Appendix C. They include a table showing pressure altitude as a function of density altitude and temperature, and four range charts showing true air speed and torque pressure for various combinations of pressure altitude and gross weight.

3.2 (U) TURBINE DATA

The AH-1G uses one Lycoming Model T53-L-13 turbine. The data from this engine are presented in tabular form in Tables 3-5 through 3-7. Table 3-5 shows air flow (Wa), fuel flow (Wf) and net thrust (Fg) for various combinations of altitude and shaft horsepower (SHP) settings. Table 3-6 shows Turbine outlet temperature versus shaft horsepower. Table 3-7 presents correction factors for air flow, fuel flow, and net thrust as a function of ambient temperature.

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The original data from the Lycoming manual from which tables 3-5 through 3-7 were generated is shown in Appendix D. They include performance curves for altitudes of 0, 5000, 10,000, 15,000, and 20,000 feet, an outlet temperature curve and ambient temperature correction curves.

Table 3-1. AH-1G Helicopter Speed and Torque Data for Long Range - Cruise Speed				
	Gross Weight: 6000 Lbs.		Gross Weight: 6500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	41.1	153	41.2	153
2000	37.3	146	37.4	146
4000	35.2	141	35.4	141
6000	33.1	136	33.3	135
8000	30.4	129	30.7	129
10000	28.0	123	28.4	122
12000	26.9	119	27.3	117
14000	25.9	114	27.0	113
16000	24.6	108	26.3	106
18000	24.5	103	26.9	99
20000	24.8	97		

	Gross Weight: 7000 Lbs.		Gross Weight: 7500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	41.2	153	41.4	152
2000	37.6	145	39.3	147
4000	35.6	140	35.8	139
6000	33.6	134	32.5	131
8000	31.1	127	31.5	125
10000	30.0	122	31.3	121
12000	28.5	115	30.6	113
14000	27.9	108	32.3	108
16000	29.5	103		

	Gross Weight: 8000 Lbs.		Gross Weight: 8500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	41.5	150	41.5	151
2000	37.9	141	39.5	146
4000	37.9	138	36.0	137
6000	35.7	129	34.3	131
8000	34.9	121	32.8	124
10000	36.9	116	32.1	116
12000			34.0	111

Table 3-1. (Cont'd) AH-1G Helicopter Speed and Torque Data for Long Range - Cruise Speed				
	Gross Weight: 9000 Lbs.		Gross Weight: 9500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	41.6	148	41.8	146
2000	39.9	142	41.5	141
4000	37.9	134	39.9	132
6000	37.9	127	41.7	126
8000	38.6	120		

Table 3-2. AH-1G Helicopter Speed and Torque Data for Long Range Intermediate Cruise Speed				
	Gross Weight: 6000 Lbs.		Gross Weight: 6500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	44.0	157	44.1	157
2000	41.6	152	41.7	152
4000	40.3	149	40.5	148
6000	38.7	145	38.9	144
8000	36.2	139	36.6	138
10000	33.9	134	34.4	132
12000	32.7	129	33.0	127
14000	31.4	124	32.3	122
16000	30.0	118	31.1	114
18000	29.2	111	30.8	106
20000	27.4	101		
	Gross Weight: 7000 Lbs.		Gross Weight: 7500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	44.1	156	44.2	156
2000	41.9	152	43.0	152
4000	40.6	148	40.9	147
6000	39.2	143	38.6	141
8000	37.0	137	37.2	135
10000	35.5	132	36.5	129
12000	34.0	124	35.4	121
14000	32.9	117	35.6	113
16000	33.2	110		

Table 3-2. (Cont'd) AH-1G Helicopter Speed and Torque
Data for Long Range Intermediate Cruise Speed

Pres. Alt. (Ft.)	Gross Weight: 8000 Lbs.		Gross Weight: 8500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	44.3	155	44.3	154
2000	43.1	151	42.2	148
4000	41.1	145	42.2	144
6000	39.8	140	40.8	137
8000	38.2	132	39.6	129
10000	37.1	124	39.9	121
12000	37.4	117		

Pres. Alt. (Ft.)	Gross Weight: 9000 Lbs.		Gross Weight: 9500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	44.4	153	44.5	150
2000	43.4	147	44.3	145
4000	42.2	140	43.4	137
6000	42.1	134	44.3	130
8000	41.1	125		

Table 3-3. AH-1G Helicopter Speed and Torque Data
for Long Range - Maximum Speed

Pres. Alt. (Ft.)	Gross Weight: 6000 Lbs.		Gross Weight: 6500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	47.5	161	47.5	161
2000	47.5	159	47.5	159
4000	47.5	156	47.6	156
6000	47.1	153	47.1	153
8000	45.2	149	45.3	148
10000	43.3	144	43.4	143
12000	41.4	139	41.4	138
14000	39.5	134	39.5	130
16000	37.6	127	37.5	123
18000	35.4	120	35.6	113
20000	30.4	106		

Table 3-3. (Cont'd) AH-1G Helicopter Speed and Torque Data for Long Range - Maximum Speed				
Pres. Alt. (Ft.)	Gross Weight: 7000 Lbs.		Gross Weight: 7500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	47.5	160	47.5	160
2000	47.5	158	47.5	157
4000	47.5	155	47.6	154
6000	47.2	152	47.1	151
8000	45.3	147	45.3	145
10000	43.3	141	43.3	137
12000	41.4	134	41.4	129
14000	39.5	126	39.5	119
16000	37.5	116		
Pres. Alt. (Ft.)	Gross Weight: 8000 Lbs.		Gross Weight: 8500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	47.6	159	47.5	157
2000	47.6	156	47.5	154
4000	47.6	153	47.5	151
6000	47.1	148	47.2	145
8000	45.3	141	45.3	136
10000	43.3	133	43.3	126
12000	41.4	122		
Pres. Alt. (Ft.)	Gross Weight: 9000 Lbs.		Gross Weight: 9500 Lbs.	
	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	47.6	156	47.5	154
2000	47.6	152	47.5	149
4000	47.6	147	47.5	142
6000	47.1	140	47.2	134
8000	45.3	130		

Table 3-4. AH-1G Helicopter Speed and Torque Data for Maximum Endurance				
	Gross Weight: 6000 Lbs.		Gross Weight: 6500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	16.3	55	16.9	57
2000	15.8	55	16.4	57
4000	15.3	55	16.0	57
6000	14.9	55	15.6	58
8000	14.5	55	15.3	58
10000	14.2	56	15.1	58
12000	14.0	56	15.1	58
14000	14.0	56	15.3	57
16000	14.1	55	15.9	56
18000	14.5	55	16.9	55
20000	15.4	54	18.8	53
22000	17.0	52	21.9	49
24000	19.7	48		
	Gross Weight: 7000 Lbs.		Gross Weight: 7500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	17.5	59	18.3	62
2000	17.1	60	17.9	62
4000	16.7	60	17.6	62
6000	16.5	60	17.4	62
8000	16.3	60	17.5	62
10000	16.3	60	17.8	61
12000	16.6	59	18.5	60
14000	17.2	58	19.8	59
16000	18.4	57	22.1	56
18000	20.5	55	25.8	52
20000	24.0	51		

Table 3-4. (Cont'd) AH-1G Helicopter Speed and Torque Data for Maximum Endurance				
	Gross Weight: 8000 Lbs.		Gross Weight: 8500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	19.0	64	19.9	66
2000	18.8	64	19.8	66
4000	18.6	64	19.8	66
6000	18.7	64	20.2	65
8000	19.0	63	21.0	64
10000	19.8	62	22.4	62
12000	21.2	60	24.8	59
14000	23.5	58	28.7	56
16000	27.4	54		
	Gross Weight: 9000 Lbs.		Gross Weight: 9500 Lbs.	
Pres. Alt. (Ft.)	Torque Pres. (PSIG)	Speed (Knots)	Torque Pres. (PSIG)	Speed (Knots)
0	20.9	67	22.1	69
2000	21.0	67	22.5	68
4000	21.3	67	23.2	67
6000	22.1	66	24.6	66
8000	23.5	64	27.0	63
10000	26.0	61	30.8	60
12000	29.3	57	36.7	54
14000	35.9	52		

Table 3-5. Engine Parameters at Standard Ambient Temperature						
	Altitude: Sea Level			Altitude: 5000 Feet		
SHP	Wa (lb/sec)	Wf (lb/hr)	Fg (lb)	Wa (lb/sec)	Wf (lb/hr)	Fg (lb)
200	6.83	263	29	6.10	243	30
400	8.45	373	50	7.55	350	50
600	9.55	470	67	8.55	440	67
800	10.35	560	82	9.30	520	84
1000	11.05	640	96	9.93	603	99
	Altitude: 10,000 Feet			Altitude: 15,000 Feet		
SHP	Wa (lb/sec)	Wf (lb/hr)	Fg (lb)	Wa (lb/sec)	Wf (lb/hr)	Fg (lb)
200	5.7	215	30	4.90	191	30
400	7.0	310	50	6.00	283	48
600	7.9	395	70	6.75	365	65
800	8.7	480	80	7.40	453	80
1000	9.4	570	100	7.65	500	90

	Altitude: 20,000 Feet		
SHP	Wa (lb/sec)	Wf (lb/hr)	Fg (lb)
200	4.6	150	29
400	5.6	270	45
600	6.3	345	62
800	6.9	445	80

Table 3-6. Referred Power Turbine Outlet Total Temperature Versus Referred Shaft Horsepower	
$SHP/\delta_{amb}\sqrt{\theta_{amb}}$	T_{to}/θ_{amb}*
400	1385
800	1440
1200	1550
1600	1645
2000	1760
2400	1920

*Note: θ_{amb} = relative temperature ratio = $\dfrac{T_{amb} \text{ @ altitude } (^{\circ}R)}{519}$

Table 3-7. Ambient Temperature Correction Factors (100% normal rated power)			
T_{amb} ($^{\circ}R$)	$\dfrac{\Delta Wa}{Wa}$	$\dfrac{\Delta Wf}{Wf}$	$\dfrac{\Delta Fg}{amb}$
420	0.355	0.440	73
440	0.290	0.350	57
460	0.220	0.260	41
480	0.145	0.170	26
500	0.070	0.080	13
520	-0.005	-0.010	-1
540	-0.070	-0.090	-13
560	-0.135	-0.160	-24
580	-0.190	-0.230	-33

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4.0   (U)   AH-1G SIGNATURE

The AH-1G surface data derived and listed in Table 2-1 was put into the HIDE model in the form of "block data" as given in Appendix A. The AH-1G turbine model (listed in Appendix B) was then run off line to derive inputs for the HIDE model. Meteorlogic and operating conditions were arbitarily selected and the HIDE program executed to generate an AH-1G signature.

The generation of a viable signature represents the completion of the AH-1G model construction. This section describes a typical signature.

4.1   (U)   INPUT DATA

The input data that was used to obtain the sample signature are given in Table 4-1.

The identification of the variable names and their units are as follows:

TAIR	=	Ambient air temperature, degrees Kelvin
PRESS	=	Ambient pressure, millibars
RMIX	=	Mixing ratio, gms H_2O/Kgm dry air
VISR	=	Visual range, KM
CFRA	=	Cloud fraction, tenths
IDAY	=	Flag, 1 = night, 2 = day
AZSUN	=	Azimuth of sun relative to LOS, degrees
ZESUN	=	Zenith of sun, degrees
WINDVL	=	Wind velocity, ft/sec
WANGLE	=	Compass heading of wind origin, degrees
RGND	=	Reflectivity of ground
ENGD	=	Emissivity of ground
TGND	=	Temperature of ground
RCLD	=	Reflectivity of cloud
HT	=	Helicopter height, KM
PSIH	=	Helicopter yaw relative to East, degrees
THETAH	=	Helicopter pitch, degrees
PHIH	=	Helicopter roll, degrees
SPEEDH	=	Helicopter speed, ft/sec
YAWV	=	Helicopter velocity vector yaw relative to air frame, degrees
PITCHV	=	Helicopter velocity vector pitch relative to air frame, degrees
ROLLV	=	Helicopter velocity vector roll relative to air frame, degrees
AMT	=	Atmospheric pressure, atmospheres
AIRTMP	=	Air temperature at helicopter altitude, deg. Kelvin

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FEFF	=	Combustion efficiency
FHTOC	=	Hydrogen to carbon ratio of fuel
FATOMS	=	Number of carbon atoms in fuel molecule
QQ1	=	1 + fuel to air ratio
XTMP	=	Exit gas temperature
AIRH20	=	Partial pressure of water vapor in air, percent
AIRC02	=	Partial pressure of carbon dioxide in air, percent
XH20	=	Partial pressure of water vapor in exhaust gas, percent
XCO2	=	Partial pressure of carbon dioxide in exhaust gas percent
AIRCP	=	Specific heat of air,
EXVEL	=	Velocity of exit gas, ft/sec
DOWNSH	=	Down wash velocity, ft/sec
DE	=	Exit diameter, inches
R	=	Range, KM
HO	=	Observer height, KM
HX	=	Helicopter position in earth coordinate system (EAST), inches
HY	=	Helicopter position in earth coordinate system (NORTH), inches
HZ	=	Helicopter position in earth coordinate system (ELEVATION), inches
OX	=	Observer position in earth coordinate system (EAST) inches
OY	=	Observer position in earth coordinate system (NORTH), inches
OZ	=	Observer position in earth coordinate system (ELEVATION), inches
PSIO	=	LOS yaw angle, degrees
THETAO	=	LOS pitch angle, degrees
PHIO	=	LOS roll angle, degrees
DELTX	=	Station number of center of gravity in body coordinate system, inches
DELTY	=	Bulkhead number of center of gravity in body coordinate system, inches
DELTZ	=	Water line number of center of gravity in body coordinate system, inches
FOVX	=	Observer field of view in azimuth, degrees
FOVY	=	Observer field of view in elevation, degrees
ANGX	=	Angular resolution in azimuth, degrees
ANGY	=	Angular resolution in elevation, degrees
LOW	=	Short wave length index
LHI	=	Long wave length index
BLASK	=	Azimuth displacements of LOS from center of gravity, resolution elements
BIAJ	=	Elevation displacement of LOS from center of gravity, resolution elements
CHIT	=	Cloud height
ECLD	=	Emissivity of cloud
PRD	=	Log plot scale factor

TABLE 4-1. (U) INPUT DATA

TAIR =	.2715000+03	PRESS =	.9307000+03	RMIX =	.1601000+01	VISD =	.5000000+01
CFRA =	.00000000	IDAY =	.1000000+01	AZSUN =	.3420000+03	ZENSUN =	.9000000+02
WINDVL =	.1000000-01	WANGLE =	.00000000	RGND =	.7000000-01	EGND =	.9300000+00
TGND =	.2715000+03	RCLD =	.1000000+01	HT(1) =	.1240000-01	PSIH =	.1590000+03
THETAH =	-.4500000+00	PHIH =	.00000000	SPEEDH =	.00000000	YAWV =	.00000000
PITCHV =	.00000000	ROLLV =	.00000000	ATM =	.00000000	AIRTMP =	.9170000+00
FEFF =	.9500000+00	FHTOC =	.2000000+01	FATOMS =	.7000000+01	QQ1 =	.1016500+01
XTMP =	.7860000+03	AIRH2O =	.2580000+01	AIRCO2 =	.00000000	XH2O =	.7630000+01
XCO2 =	.3800000+01	XCP =	.2660000+00	AIRCP =	.2400000+00	EXVFL =	.3015000+03
DOWNSH =	.4124000+02	DE =	.1650000+02	R(1) =	.8850000-01	HQ(1) =	.1000000-02
HX =	.3320000+04	HY =	.6400000+03	HZ =	.1250000-01	QX =	.00000000
OY =	.00000000	OZ =	.1000000-02	PSIO =	.1100000+02	THETAO =	.00000000
PHIO =	.00000000	DELTX =	.1900000+03	DELTY =	-.4000000+02	DELTZ =	-.9000000+02
FOVX =	.5400000+01	FOVY =	.2700000+01	ANGX =	.9000000-01	ANGY =	.9000000-01
LGW =	.3200000+02	LHI =	.5700000+02	BIASK =	-.3000000+01	BIASJ =	.5000000+01
CHIT =	.1000000+01	ECLD =	.1000000+01	PRD =	***********		

4.2 (U) <u>LOG PLOT SIGNATURE</u>

The signature predicted for these initial conditions is shown in figure 4-1. This figure depicts the spatial intensity distribution of the signature.

The picture consists of a mosaic of 30 by 60 elements. The apparent effective radiance of each element is depicted by a 2 digit number. The first digit represents the characteristic of the logarithym of the radiance multiplied by a scale factor and the second digit the first number of the mantissa.

The value of the radiance is typically less than unity. Therefore it is multiplied by a scale factor PRD. If the product of the radiance times PRD was 267.5, then its logarithym would be log 10(267.5) = 2.4273, which when rounded off to the first decimal and multiplied by 10 becomes 24. Thus the two digit value printed out for this surface intercept would be 24.

The advantage of using logrithyms is in obtaining a large dynamic range with the fewest digits. For example, the surface radiancies in figure 4.1 are in the the twenties while the hot gas values are in the forties. This indicates at a glance that the hot gas is two orders of magnitude more radiant then the surface.

The background radiance values have been suppressed for picture clearity except for the last column and row. This permits determining at a glance what the background level is and if there are any gradients present.

At the bottom of the picture frame are three lines of real numbers which define aspects of the intergrated signature in various ways.

The first line gives the components of contrast irradiance which comprise the composite signature. The first number is the total positive con-

FIGURE 4-1. (U) LOG PLOT SIGNATURE

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trast irradiance, the second number is the total negative contrast irradiance and the third number is the sum of the absolute values of contrast irradiance components.

The second line gives the absolute irradiance values. The first number is the absolute target irradiance, the second number is the absolute irradiance of the background covered by the target, and the third is the contrast irradiance obtained by subtracting the first two numbers.

The third line containing a single number is the apparent effective radiant intensity of the target.

In the above, the irradiance numbers have the standard units, watts/cm^2, the radiant intensity, watts/ster, and the radiant values in the log plot, W/cm^2/ster.

All signature values are weighted for the sensor spectral response.

4.3 (U) SPECTRAL PLOT

The HIDE program also prints out a plot of the spectral radiant intensity of the signature and its composition as shown in figure 4-2.

This plot is in the form of a number pattern wherein the user can connect the numbers and draw the curves.

The identification of the sysmbols and their priority are listed below. (i.e. If the points on more then one curve fall on the same print location, only one character is printed out over riding the others. Thus number 1 (X) would predominate over all the others, number 2(c) would prempt 3 through 5 etc.).
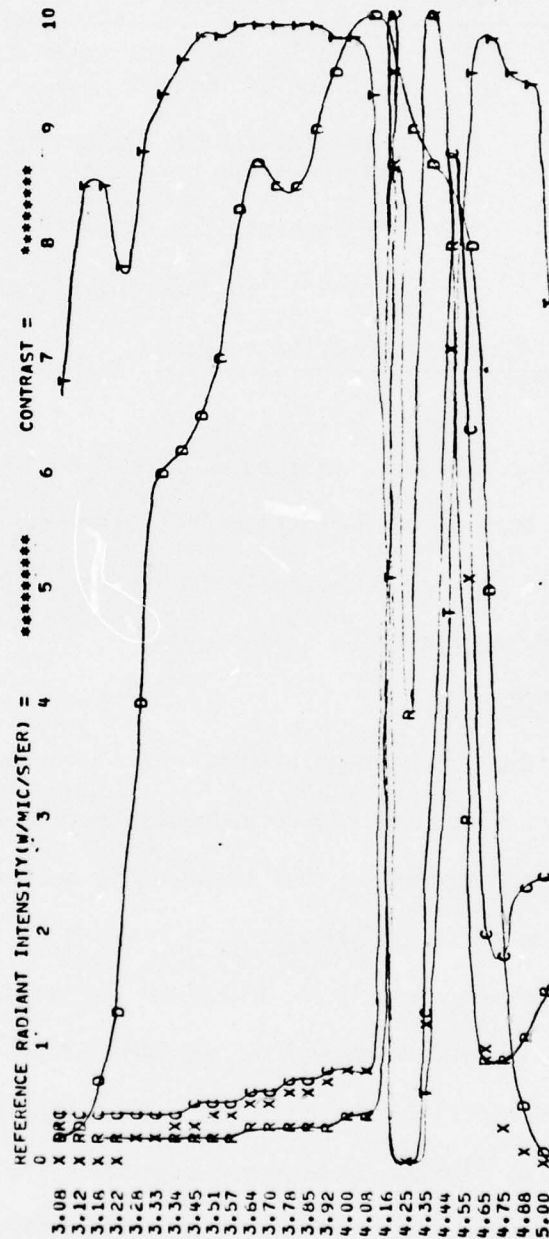
FIGURE 4-2. (U) SPECTRAL PLOT

4-7

TABLE 4-2.   (U)   SPECTRAL PRIORITIES

PRIORITY	SYMBOL	DEFINITION	REFERENCE
1	X	Effective apparent spectral radiant intensity	Contrast
2	C	Spectral radiant intensity at receiver	Contrast
3	T	Atomspheric transmission	100%
4	R	Spectral radiant intensity	Rad. Int.
5	D	Detector response	100%

(U) The vertical coordinate, calibrated from 0 to 10, represents 0 to 100 percent. The horizontal coordinate is calibrated in wavelengths. Each curve is normalized to some reference value which is printed out along the vertical coordinate and specified in Table 4-2.

4.4   (U)   BODY INTERCEPT PLOT

A body intercept plot is also printed out as shown in figure 4-3. This is in a mosaic format on a one for one correspondance with the LOG PLOT of the signature. The difference is that the 2 digit numbers given here are the index numbers of the surface elements.

Only body surfaces are shown here, the plume surfaces have been deleted. This plot may be super imposed on the LOG PLOT to investigate the origin of the signature contributions (i.e. tail boom heating, solar glint from windows, etc.). The background of zeros represent the fact that no intercepts of the helicopter structure were obtained at the corresponding resolution elements.

FIGURE 4-3. (U) BODY INTERCEPT PLOT

4.5 (U) <u>GREY SCALE PLOT</u>

The HIDE model also generates a grey scale plot of the spatial distribution of intensity of the signature as shown in figure 4-4.

This is based on a 10 level grey scale using symbols to depict the density levels.

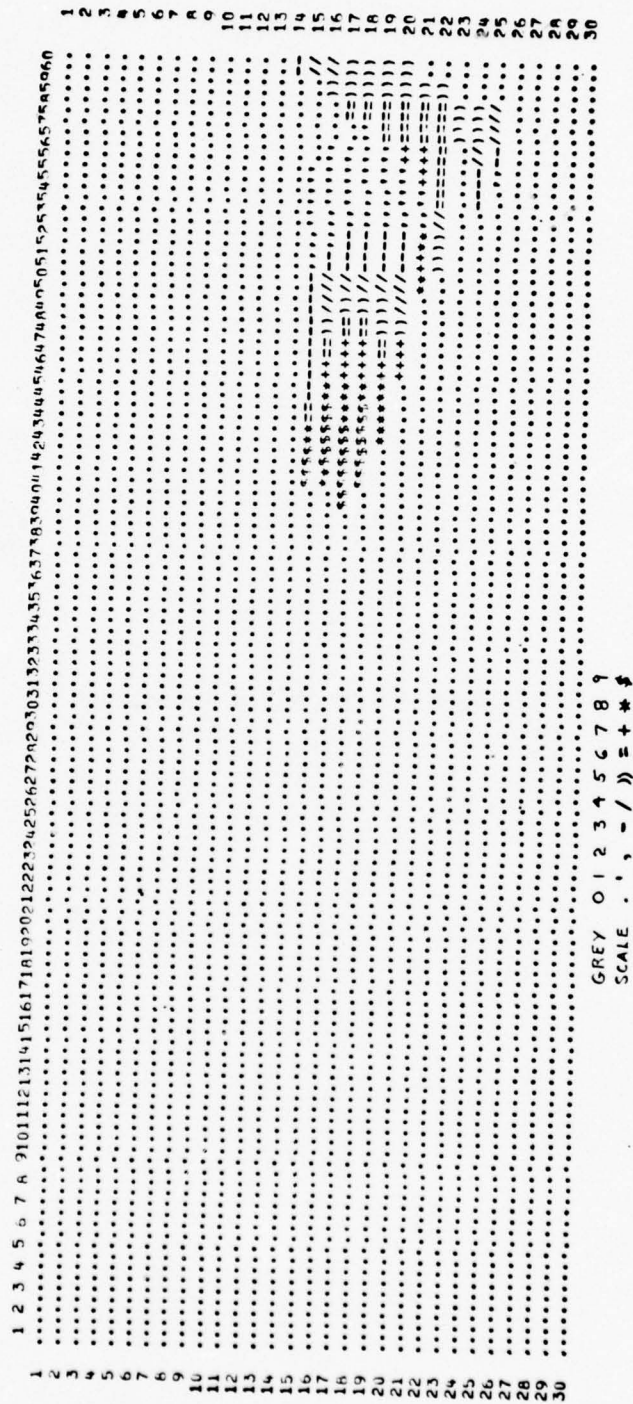This plot enables one to find hot spots quickly and track them through the BODY and LOG PLOTS.

GREY 0 1 2 3 4 5 6 7 8 9
SCALE . ' , - /)) = + * $

FIGURE 4-4. (U) GREY SCALE PLOT

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APPENDIX A (U)

BLOCK DATA FOR BODY IN THE HIDE MODEL

```
BLOCK DATA
COMMON/STRT/ STRUC(120,11)
COMMON/NMS/ NUMSRF(120)
COMMON/IIGM/IG(120)
COMMON/NPL/ NPLMNS
COMMON/NTP/ NTYP(120)
COMMON/NUSF/ NUSURF,NPAR
COMMON/NREF/ NSHAFT,NTLPIP
DATA NPLMNS/4/
DATA NSHAFT/53/
DATA NTLPIP/84/
DATA NPAR/11/
DATA NUSURF/95/
DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=1,7)/
*2H 1, -36.010,  54.000,    .000,    .000,  90.000,
*      .001, 360.000,   8.000,    .000,  90.000,    .000, 6, 1,
*2H 2, -36.000,  54.000,    .000,  -8.000,   8.000,
*    -8.000,   8.000,    .000,    .000,  90.000,    .000, 1, 1,
*2H 3,   1.600,  44.850,    .000, -60.650, -41.400,
*  169.040, 190.960,    .000, -90.000,    .000, -24.550, 3, 1,
*2H 4,   1.550,  57.500,    .000, -88.500, -39.300,
*  168.500, 191.500,    .000, -90.000,    .000,  17.030, 3, 1,
*2H 5, -18.500,  54.000,   4.280, -35.800, -17.900,
*  155.900, 180.000,    .000,-102.000, -90.000,    .000, 3, 1,
*2H 6, -18.500,  54.000,  -4.280,  17.900,  35.800,
*      .000,  24.100,    .000, 102.000, -90.000,    .000, 3, 1,
*2H 7, -83.000,  64.000,  18.000,    .000,  10.000,
*      .000,  30.030,    .000, -12.000,    .000, -90.000, 1, 1/
 DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=8,15)/
*2H 8, -83.000,  64.000, -18.000,    .000,  10.000,
*      .000,  30.030,    .000,  12.000,    .000, -90.000, 1, 1,
*2H 9, -71.250,  21.620,    .000,    .000,  25.000,
*      .001, 360.000,  10.000,    .000,    .000,    .000, 4, 1,
*2H10, -71.250,  21.620,    .000,    .000,  10.000,
*      .001, 360.000,    .000,    .000,    .000,    .000, 2, 1,
*2H11,  -9.900,  54.010,   2.450,  26.670,  74.670,
*      .000,  16.700,    .000,  78.000,  90.000,    .000, 3, 1,
*2H12,  -9.900,  54.010,  -2.450, -74.670, -26.670,
*  163.300, 180.000,    .000, -78.000,  90.000,    .000, 3, 1,
*2H13,  31.510,  54.000,  18.000,-198.840,-114.500,
*  174.900, 180.000,    .000, -90.000, -90.000,    .000, 3, 1,
*2H14,  31.510,  54.000, -18.000, 114.500, 198.840,
*      .000,   5.100,    .000,  90.000, -90.000,    .000, 3, 1,
*2H15, -82.990,  54.010,  18.000,    .000,  84.340,
*      .000,  27.010,    .000,  90.000,  90.000,    .000, 1, 1/
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      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=16,23)/
     *2H16, -82.990,  54.010, -18.000, -84.340,    .000,
     *      .000, 27.010,    .000,-90.000, 90.000,    .000, 1, 1,
     *2H17, -53.500, 70.000, -11.720,    .000, 23.440,
     *      .000, 16.000,    .000,    .000, 90.000,    .000, 1, 1,
     *2H18, -53.490, 69.990,    .000, -8.000,  8.000,
     *   -40.900,    .000,    .000,    .000, 43.800,    .000, 1, 1,
     *2H19, -36.000, 53.200,  8.000, 15.000, 64.100,
     *      .001, 360.000,  8.750,    .000, -54.950,    .000, 5, 1,
     *2H20, -36.000, 53.200, -8.000, 15.000, 64.100,
     *      .001, 360.000,  8.750,    .000, -54.950,    .000, 5, 1,
     *2H21, -50.370, 64.000, 11.060, -35.600, -5.570,
     *   143.700, 180.000,    .000,-102.000, -90.000,    .000, 3, 1,
     *2H22, -50.370, 64.000, -11.060,  5.570, 35.600,
     *      .000, 36.300,    .000, 102.000, -90.000,    .000, 3, 1,
     *2H23, -82.990, 98.300,    .000, -8.000,  8.000,
     *   -54.900,    .000,    .000,    .000,  5.100,    .000, 1, 1/
      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=24,31)/
     *2H24,-167.875,  95.725,  8.000,    .000, 84.500,
     *      .001, 360.000, 10.000,    .000, 95.100,    .000, 4, 1,
     *2H25,-167.875,  95.725, -8.000,    .000, 84.500,
     *      .001, 360.000, 10.000,    .000, 95.100,    .000, 4, 1,
     *2H26, -83.000, 64.000, 18.000, -24.450,    .000,
     *   -87.500,    .000,    .000,    .000,  5.100, -90.000, 1, 1,
     *2H27, -83.000, 64.000, -18.000,    .000, 24.450,
     *   -87.500,    .000,    .000,    .000,  5.100, 90.000, 1, 1,
     *2H28,-167.330, 105.675,    .000, -8.000,  8.000,
     *      .000, 25.350,    .000,    .000,  5.100,    .000, 1, 1,
     *2H29,-251.000, 68.000, 18.000,    .000, 41.000,
     *      .000, 83.670,    .000,    .000,    .000, -90.000, 1, 1,
     *2H30,-251.000, 68.000, -18.000, -41.000,    .000,
     *      .000, 83.670,    .000,    .000,    .000, 90.000, 1, 1,
     *2H31,-251.000, 95.675,  8.000,    .000, 83.670,
     *      .001, 360.000,  6.820,    .000, 90.000,    .000, 5, 1/
      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=32,39)/
     *2H32,-251.000, 95.675, -8.000,    .000, 83.670,
     *      .001, 360.000,  6.820,    .000, 90.000,    .000, 5, 1,
     *2H33,-200.000, 105.675,    .000, -8.000,  8.000,
     *      .000, 32.670,    .000,    .000,    .000,    .000, 1, 1,
     *2H34,-586.170, 68.000,    .500,-335.250,-100.500,
     *   173.020, 180.000,    .000, 90.000, 90.000, -3.000, 3, 1,
     *2H35,-586.170, 68.000, -.500,-335.250,-100.500,
     *   180.000, 186.980,    .000, 90.000, -90.000, -3.000, 3, 1,
     *2H36,-596.000, 69.203,    .000,-347.830,-110.330,
     *   177.040, 182.960,    .000, 90.000, 180.000, -6.980, 3, 1,
     *2H37,-197.000, 95.000, 18.000,    .000, 17.200,
     *      .001, 360.000,  3.000,    .000, -90.000,    .000, 5, 1,
     *2H38,-197.000, 95.000, -18.000,    .000, 17.200,
     *      .001, 360.000,  3.000,    .000, -90.000,    .000, 5, 1,
     *2H39,-197.000, 76.800, 18.000,    .000, 17.200,
     *      .001, 360.000,  3.000,    .000, -90.000,    .000, 5, 1/
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 DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=40,47)/
*2H40,-197.000,  76.800,  -18.000,      .000,  17.200,
*      .001, 360.000,   3.000,      .000, -90.000,    .000, 5, 1,
*2H41,-485.670,  68.000,      .000,      .000, 200.000,
*      .001, 360.000,   5.000,      .000,  90.000,    .000, 4, 1,
*2H42,-485.670,  68.000,      .000,      .000, 180.000,
*      .001, 360.000,   5.000,      .000, -90.000,    .000, 6, 1,
*2H43,-485.670,  68.000,      .000,  -5.750,   5.750,
*      .000,  13.100,      .000,      .000,  90.000,    .000, 1, 1,
*2H44,-597.470, 183.800,      .000,  50.400, 128.800,
*   37.000,  51.000,      .000,      .000,      .000, -90.000, 3, 1,
*2H45,-520.670, 119.650,      .000,      .000,  14.750,
*      .001, 360.000,   1.000,      .000,      .000, -90.000, 4, 1,
*2H46,-520.670, 119.650,  14.750,  -4.625,   4.625,
*  -52.500,  52.500,      .000,      .000, -45.000, -90.000, 1, 1,
*2H47,-397.000,  56.330,      .000, -41.530,  41.330,
*  -21.400,      .000,      .000,      .000,      .000,    .000, 1, 1/
 DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=48,54)/
*2H48,-251.000,  27.000,      .000, -18.000,  18.000,
*      .000, 168.000,      .000,      .000,      .000,    .000, 1, 1,
*2H49,-117.400,  27.000,  10.000, -34.400,    .000,
*  171.040, 180.000,      .000,  90.000,  90.000,    .000, 5, 1,
*2H50,-117.400,  27.000, -10.000,     .000,  34.400,
*      .000,   8.960,      .000, -90.000,  90.000,    .000, 5, 1,
*2H51, -83.000,  27.000,      .000, -10.000,  10.000,
*      .000,   5.580,      .000,      .000,  90.000,    .000, 1, 1,
*2H52,-117.400,  27.000,      .000, -10.000,  10.000,
*      .000,  34.810,      .000,      .000,   8.960,    .000, 1, 1,
*2H53,-200.000, 127.350,      .000,      .000,  25.270,
*      .001, 360.000,   1.000,      .000,      .000,    .000, 4, 1,
*2H54,-200.000, 152.620,      .000, -13.000,  13.000,
*-264.000, 264.000,      .000,  45.000,      .000,    .000, 1, 1/
 DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=55,61)/
*2H55,-382.280,  56.330,      .000, -14.720,    .000,
*  109.600, 250.400,      .000, -90.000,      .000,    .000, 3, 1,
*2H56,-215.720,  58.690,      .000, -61.940,  61.940,
*      .000,  30.300,      .000,      .000, -14.000,    .000, 1, 1,
*2H57,-215.720,  58.690,      .000, -61.940,  61.940,
*      .000,  31.000,      .000,      .000,  -7.000,    .000, 1, 1,
*2H58,-186.120,  66.070,  61.940,      .000,   5.000,
*      .001, 360.000,      .000,      .000,      .000, -90.000, 2, 1,
*2H59,-186.120,  66.070, -61.940,      .000,   5.000,
*      .001, 360.000,      .000,      .000,      .000,  90.000, 2, 1,
*2H60,-215.720,  58.690,  61.940,      .000,  30.500,
*   95.000, 113.000,      .000,      .000,      .000, -90.000, 2, 1,
*2H61,-215.720,  58.690, -61.940,      .000,  30.500,
*   67.000,  85.000,      .000,      .000,      .000,  90.000, 2, 1/
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      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=62,68)/
     *2H62,-183.130, 105.675,     .000,  -8.850,   9.450,
     *     .001, 360.000,  13.100,    .000, -34.000,    .000, 4, 1,
     *2H63,-193.350, 120.800,     .000,    .000,   8.850,
     *     .001, 360.000,  56.000,    .000, 146.000,    .000, 5, 1,
     *2H64,-193.350, 120.800,     .000, -13.100,  13.100,
     *     .000,   8.860,    .000,    .000,  56.000,    .000, 1, 1,
     *2H65,-193.350, 120.800,  13.100,    .000,  18.000,
     *     .000,  34.000,    .000,    .000,    .000, -90.000, 5, 1,
     *2H66,-193.350, 120.800, -13.100, -18.000,    .000,
     *  146.000, 180.000,    .000,    .000,    .000,  90.000, 5, 1,
     *2H67,-295.600,  68.000,    .000, -54.500,    .000,
     *  118.063, 136.876,    .000,  14.832,    .000, -75.644, 3, 1,
     *2H68,-295.600,  68.000,    .000,    .000,  54.500,
     *   43.124,  61.937,    .000, -14.832,    .000,  75.644, 3, 1/
      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=69,74)/
     *2H69,-193.350, 120.800,  13.100, -54.500,    .000,
     *  118.063, 136.876,    .000,-165.168,    .000,  75.644, 5, 1,
     *2H70,-193.350, 120.800, -13.100,    .000,  54.500,
     *   43.124,  61.937,    .000, 165.168,    .000, -75.644, 5, 1,
     *2H71,-193.350, 120.800,  13.100, -52.800,    .000,
     *  135.000, 180.000,    .000, 180.000,    .000,  90.000, 3, 1,
     *2H72,-193.350, 120.800, -13.100, -52.800,    .000,
     *  180.000, 225.000,    .000,    .000,    .000,  90.000, 3, 1,
     *2H73,-187.720, 120.800,    .000,    .000,  14.000,
     *     .001, 360.000,    .000,    .000,    .000,    .000, 2, 1,
     *2H74,-205.720, 120.800,    .000, -14.000,  14.000,
     *     .000,  18.000,    .000,    .000,    .000,    .000, 1, 1/
      DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=75,81)/
     *2H75,-245.720, 120.800,    .000, -40.000,    .000,
     *  160.700, 199.300,    .000,  90.000,    .000,    .000, 3, 1,
     *2H76,-200.000, 127.350,    .000,    .000,  10.650,
     *     .001, 360.000,    .000,    .000,    .000,    .000, 2, 1,
     *2H77,-200.000, 152.620,    .000,  25.270,  32.000,
     *     .001, 360.000,  22.750,    .000, 180.000,    .000, 5, 1,
     *2H78,-251.000,  68.000,   8.000,    .000,  83.670,
     *     .001, 360.000,  10.000,    .000,  90.000,    .000, 4, 1,
     *2H79,-251.000,  68.000,  -8.000,    .000,  83.670,
     *     .001, 360.000,  10.000,    .000,  90.000,    .000, 4, 1,
     *2H80,-251.000,  68.000,   8.000,    .001, 180.000,
     *     .001, 360.000,  10.000,    .000,    .000,    .000, 6, 1,
     *2H81,-251.000,  68.000,  -8.000,    .001, 180.000,
     *     .001, 360.000,  10.000,    .000,    .000,    .000, 6, 1/
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DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=82,89)/
*2H82,-323.800, 85.900,    .000, 38.400, 58.900,
*    .001, 360.000, 15.510,    .000, 90.000,    .000, 5, 1,
*2H83,-285.400, 85.900,    .000,    .000, 10.650,
*    .001, 360.000,    .000,    .000,-90.000,    .000, 2, 1,
*2H84,-283.330, 85.900,    .000,    .000,  4.100,
*    .001, 360.000,  8.023,    .000,-79.000,    .000, 4, 1,
*2H85,-283.330, 85.900,    .000,    .000,  8.023,
*    .001, 360.000,  4.100,    .000,-79.000,    .000, 2, 1,
*2H86,-264.900, 85.900,    .000,    .000, 16.350,
*    .001, 360.000,    .000,    .000,-90.000,    .000, 2, 1,
*2H87,-263.400, 85.900,    .100,    .000, 51.000,
*    .001, 360.000, 16.350,  5.250, 90.000,    .000, 4, 1,
*2H88,-263.400, 85.900,   -.100,    .000, 51.000,
*    .001, 360.000, 16.350, -5.250, 90.000,    .000, 4, 1,
*2H89,-212.700, 85.900,  4.750,    .000, 16.350,
*    .001, 360.000,    .000,  5.250, 90.000,    .000, 2, 1/
DATA (NUMSRF(I),(STRUC(I,J),J=1,11),IG(I),NTYP(I),I=90,95)/
*2H90,-212.700, 85.900, -4.750,    .000, 16.350,
*    .001, 360.000,    .000, -5.250, 90.000,    .000, 2, 1,
*2H91,-596.000, 68.000,    .000,-345.000,-110.330,
* 177.000, 183.000,    .000, 90.000,    .000,    .000, 3, 1,
*2H92,-167.330, 95.675, 18.000,    .000, 59.100,
*    .000, 27.625,    .000, 90.000, 90.000, -6.820, 1, 1,
*2H93,-167.330, 95.675,-18.000,-59.100,    .000,
*    .000, 27.625,    .000,-90.000, 90.000,  6.820, 1, 1,
*2H94,-186.120, 66.070,    .000,-61.940, 61.940,
*    .001, 360.000,  3.75,    .000,    .000, 90.000, 4, 1,
*2H95, -83.000, 32.000,    .000,-18.000, 18.000,
*    .001,   5.000,    .000,    .000, 90.000,    .000, 1, 1/
END
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APPENDIX B (U)

TURBINE MODEL FOR

AH-1G

HELICOPTER

LISTING AND BLOCK DATA

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AHTURB -- PAGE 1   08.53.06   73/08/23

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5 PRØGRAM AH1G(ØUTPUT)
6 PRINT,* AH-1G FLIGHT/TURBIN MØDEL ØPERATING CØNDITIØNS *
10*C UPDATED 8/8/73 TØ INCLUDE PHILLIPS INTEPØLATIØN AND RØTØR
20 INTEGER THRØST,HELØGW
25 INTEGER WT,TABLE
30*C   THRØST = THRØTTLE SETTING  (INTERGER)
40*C   1 = CRUSE
50*C   2 = INTERMEDIATE CRUSE
60*C   3 = MAXIMUM SPEED
65*C   4 = MAXIMUN INDURANCE
70 THRØST=1
75*C HELØGW = HELICØPTER GRØSS WEIGHT, LBS (INTERGER)
80*C   VALUES = 6000,6500,7000,7500,8000,8500,9000,9500
85 HELØGW = 8000
90*C   A = ALTITUDE, FEET (REAL)
100  A=2000.
110*C TEMP = AMBIENT AIR TEMPERATURE, DEG CENTIGRADE (REAL)
120 TEMP=15.
130 DIMENSIØN HEIGHT( 13)
160 DIMENSIØN V1T4(13),V2T4(12),V3T4(11),V4T4(10),V5T4(9),V6T4(8),
170+ALT(4)
180 DIMENSIØN Q1T1(11),Q2T1(10),Q3T1(9),Q4T1(8),Q5T1(7),Q6T1(6),
190+Q7T1(5),Q8T1(4)
200 DIMENSIØN Q1T2(11),Q2T2(10),Q3T2(9),Q4T2(8),Q5T2(7),Q6T2(6),
210+Q7T2(5),Q8T2(4)
220 DIMENSIØN Q1T3(11),Q2T3(10),Q3T3(9),Q4T3(8),Q5T3(7),Q6T3(6),
230+Q7T3(5),Q8T3(4)
240 DIMENSIØN Q1T4(13),Q2T4(12)
242 DIMENSIØN Q3T4(11),Q4T4(10),Q5T4(9),Q6T4(8),
250+Q7T4(8),Q8T4(7)
260 DIMENSIØN V1T1(11),V2T1(10),V3T1(9),V4T1(8),V5T1(7),V6T1(6),
270+V7T1(5),V8T1(4)
280 DIMENSIØN V1T2(11),V2T2(10),V3T2(9),V4T2(8),V5T2(7),V6T2(6),
290+V7T2(5),V8T2(4)
300 DIMENSIØN V1T3(11),V2T3(10),V3T3(9),V4T3(8),V5T3(7),V6T3(6),
310+V7T3(5),V8T3(4),
320+V7T4(8),V8T4(7)
330 DIMENSIØN ØAT0(3),ØAT4(3),ØAT8(3),ØAT12(3)
340 DIMENSIØN GW(3)
350 DIMENSIØN VEL(10),PITCH(10)
360 DIMENSIØN S0(5),W1(5),W2(5),W3(5),W4(5),W5(5)
370 DIMENSIØN U1(5),U2(5),U3(5),U4(5),U5(5)
380 DIMENSIØN W9(5),U9(5)
390 DIMENSIØN F1(5)
400 DIMENSIØN A0(5),T0(5),D1(5)
410 DIMENSIØN T2(9),C1(9),C2(9),C3(9)
420 DIMENSIØN R1(6),R2(6)
430 REAL L1( 5)
440 REAL M1,M2,L
450 DATA (VEL(I4),I4=1,10)/0.,10.,20.,30.,40.,50.,60.,70.,80.,90./
460 DATA (PITCH(I4),I4=1,10)/.45,.20,-.25,-.90,-1.7,-2.5,-3.7,-5.05,
470+-6.35,-8./
480 DATA (ALT(I5),I5=1,4)/0.,4000.,8000.,12000./
490 DATA (GW(I6),I6=1,3)/5000.,7000.,9000./
500 DATA (ØAT0(I7),I7=1,3)/-40.,10.,50./
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510 DATA (0AT4(I8),I8=1,3)/-40.,10.,50./
520 DATA (0AT8(I9),I9=1,3)/-40.,10.,50./
530 DATA (0AT12(I10),I10=1,3)/-40.,10.,20./
540 DATA (S0(I1),I1=1,5)/200.,400.,600.,800.,1000./
550 DATA (W1(I1),I1=1,5)/6.83,8.45,9.55,10.35,11.05/
560 DATA (W2(I1),I1=1,5)/6.10,7.55,8.55,9.30,9.99/
570 DATA (W3(I1),I1=1,5)/5.7,7.0,7.9,8.7,9.4/
580 DATA (W4(I1),I1=1,5)/4.9,6.0,6.75,7.40,7.80/
590 DATA (W5(I1),I1=1,5)/4.3,5.3,6.0,6.5,6.7/
600 DATA (U1(I2),I2=1,5)/263.,373.,470.,560.,640./
610 DATA (U2(I2),I2=1,5)/243.,350.,440.,520.,603./
620 DATA (U3(I2),I2=1,5)/215.,310.,395.,480.,570./
630 DATA (U4(I2),I2=1,5)/191.,283.,365.,453.,560./
640 DATA (U5(I2),I2=1,5)/175.,260.,345.,445.,545./
650 DATA (F1(I3),I3=1,5)/29.,50.,67.,82.,96./
660 DATA (A0(I4),I4=1,5)/0.,5000.,10000.,15000.,20000./
670 DATA (T0(I4),I4=1,5)/519.,501.,483.,465.,447./
680 DATA (D1(I4),I4=1,5)/.00238,.00205,.001755,.001493,.0012681 /
690 DATA (L1(I4),I4=1,5)/1.000,.832,.688,.564,.460/
700 DATA (T2(I5),I5=1,9)/420.,440.,460.,480.,500.,520.,540.,560.,580./
710 DATA (C1(I5),I5=1,9)/.355,.290,.22,.145,.07,-.005,-.07,-.135,-.19/
720 DATA (C2(I5),I5=1,9)/.44,.35,.26,.17,.08,-.01,-.09,-.16,-.23/
730 DATA (C3(I5),I5=1,9)/73.,57.,41.,26.,13.,-1.,-13.,-24.,-33./
740 DATA (R1(I6),I6=1,6)/400.,800.,1200.,1600.,2000.,2400./
750 DATA (R2(I6),I6=1,6)/1385.,1464.,1550.,1647.,1763.,1920./
760 DATA G/32.2/
770 DATA H/.24/
780 DATA E/778./
790 DATA(HEIGHT(K1),K1=1,13)/0.,2000.,4000.,6000.,8000.,10000.,
800+12000.,14000.,16000.,18000.,20000.,22000.,24000. /
810 DATA(Q5T4(K1),K1=1,9)/19.0,18.8,18.6,18.7,19.0,19.8,21.2,23.5,
820+27.4/
830 DATA(Q6T4(K1),K1=1,8)/19.9,19.8,19.8,20.2,21.0,22.4,24.8,28.7/
840 DATA(Q7T4(K1),K1=1,8)/20.9,21.0,21.3,22.1,23.5,26.0,29.3,35.9/
850 DATA(Q8T4(K1),K1=1,7)/22.1,22.5,23.2,24.6,27.0,30.8,36.7/
860 DATA(Q1T2(K1),K1=1,11)/44.0,41.6,40.3,38.7,36.2,33.9,
870+32.7,31.4,30.0,29.2,27.4/
880 DATA(V2T2(K1),K1=1,10)/157.,152.,148.,144.,138.,132.,
890+127.,122.,114.,106./
900 DATA(Q2T2(K1),K1=1,10)/44.1,41.7,40.5,38.9,36.,34.4,
910+33.0,32.3,31.1,30.8/
920 DATA(V3T2(K1),K1=1,9)/156.,152.,148.,143.,137.,132.,124.,
930+117.,110./
940 DATA(Q3T2(K1),K1=1,9)/44.1,41.9,40.6,39.2,37.0,35.5,34.0,32.9,
950+33.2/
960 DATA(V4T2(K1),K1=1,8)/156.,152.,147.,141.,135.,129.,121.,113./
970 DATA(Q4T2(K1),K1=1,8)/44.2,43.0,40.9,38.6,37.2,36.5,35.4,35.6/
980 DATA(V5T2(K1),K1=1,7)/155.,151.,145.,140.,132.,124.,117./
990 DATA(Q5T2(K1),K1=1,7)/44.3,43.1,41.1,39.8,38.2,37.1,37.4/
1000 DATA(V6T2(K1),K1=1,6)/154.,148.,144.,137.,129.,121./
1010 DATA(Q6T2(K1),K1=1,6)/44.3,42.2,42.2,40.8,39.6,39.9/
1020 DATA(V7T2(K1),K1=1,5)/152.,147.,140.,134.,125./
1030 DATA(Q7T2(K1),K1=1,5)/44.4,43.1,42.2,42.1,41.7/
1040 DATA(V8T2(K1),K1=1,4)/150.,145.,137.,130./
1050 DATA(Q8T2(K1),K1=1,4)/44.5,44.3,43.4,44.3/
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1060 DATA(V1T4(K1),K1=1,13)/55.,55.,55.,55.,55.,56.,56.,56.,55.,55.,
1070+54.,52.,48./
1080 DATA(Q1T4(K1),K1=1,13)/16.3,15.8,15.3,14.9,14.5,14.2,14.0,14.0,
1090+14.1,14.5,15.4,17.0,19.7/
1100 DATA(V2T4(K1),K1=1,12)/57.,57.,57.,58.,58.,58.,58.,57.,56.,55.,
1110+53.,49./
1120 DATA(Q2T4(K1),K1=1,12)/16.9,16.4,16.0,15.6,15.3,15.1,15.1,15.3,
1130+15.9,16.9,18.8,21.9/
1140 DATA(V3T4(K1),K1=1,11)/59.,60.,60.,60.,60.,60.,59.,58.,57.,55.,
1150+51./
1160 DATA(Q3T4(K1),K1=1,11)/17.5,17.1,16.7,16.5,16.3,16.3,16.6,17.2,
1170+18.4,20.5,24.0/
1180 DATA(V4T4(K1),K1=1,10)/62.,62.,62.,62.,62.,61.,60.,59.,56.,52./
1190 DATA(Q4T4(K1),K1=1,10)/18.3,17.9,17.6,17.4,17.5,17.8,18.5,19.8,
1200+22.1,25.8/
1210 DATA(V5T4(K1),K1=1,9)/64.,64.,64.,64.,63.,62.,60.,58.,54./
1220 DATA(V6T4(K1),K1=1,8)/66.,66.,66.,65.,64.,62.,59.,56./
1230 DATA(V7T4(K1),K1=1,8)/67.,67.,67.,66.,64.,61.,57.,52./
1240 DATA(V8T4(K1),K1=1,7)/69.,68.,67.,66.,63.,60.,54./
1250 DATA (V1T1(K1),K1=1,11)/153.,146.,141.,136.,129.,123.,119.,114.,
1260+108.,103.,97./
1270 DATA(Q1T1(K1),K1=1,11)/41.1,37.3,35.2,33.1,30.4,28.0,26.9,25.9,
1280+24.6,24.5,24.8/
1290 DATA(V2T1(K1),K1=1,10)/153.,146.,141.,135.,129.,12.,117.,113.,
1300+106.,99./
1310 DATA(Q2T1(K1),K1=1,10)/41.2,37.4,35.4,33.3,30.7,28.4,27.3,27.0,
1320+26.3,26.9/
1330 DATA(V3T1(K1),K1=1,9)/153.,145.,140.,134.,127.,122.,115.,
1340+108.,103./
1350 DATA(Q3T1(K1),K1=1,9)/41.2,37.6,35.6,33.6,31.1,30.0,28.5,27.9,
1360+29.5/
1370 DATA(V4T1(K1),K1=1,8)/152.,147.,139.,131.,125.,121.,113.,108./
1380 DATA(Q4T1(K1),K1=1,8)/41.4,39.3,35.8,32.5,31.5,31.3,30.6,32.3/
1390 DATA(V5T1(K1),K1=1,7)/151.,146.,137.,131.,124.,116.,111./
1400 DATA(Q5T1(K1),K1=1,7)/41.5,39.5,36.0,34.3,32.8,32.1,34.0/
1410 DATA(V6T1(K1),K1=1,6)/150.,141.,138.,129.,121.,116./
1420 DATA(Q6T1(K1),K1=1,6)/41.5,37.9,37.9,35.7,34.9,36.9/
1430 DATA(V7T1(K1),K1=1,5)/148.,142.,134.,127.,120./
1440 DATA(Q7T1(K1),K1=1,5)/41.6,39.9,37.9,37.9,38.6/
1450 DATA(V8T1(K1),K1=1,4)/146.,141.,132.,126./
1460 DATA(Q8T1(K1),K1=1,4)/41.8,41.5,39.9,41.7/
1470 DATA(V1T2(K1),K1=1,11)/157.,152.,149.,145.,139.,
1480+134.,129.,124.,118.,111.,101./
1490 DATA(V1T3(K1),K1=1,11)/161.,159.,156.,153.,149.,144.,139.,
1500+134.,127.,120.,106./
1510 DATA(Q1T3(K1),K1=1,11)/47.5,47.5,47.5,47.1,45.2,43.3,41.4,
1520+39.5,37.6,35.4,30.4/
1530 DATA(V2T3(K1),K1=1,10)/161.,159.,156.,153.,148.,143.,138.,
1540+130.,123.,113./
1550 DATA(Q2T3(K1),K1=1,10)/47.5,47.5,47.6,47.1,45.3,43.4,
1560+41.4,39.5,37.5,35.6/
1570 DATA(V3T3(K1),K1=1,9)/160.,158.,155.,152.,147.,
1580+141.,134.,126.,116./
1590 DATA(Q3T3(K1),K1=1,9)/47.5,47.5,47.5,47.2,45.3,43.3,
1600+41.4,39.5,37.5/
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1610 DATA(V4T3(K1),K1=1,8)/160.,157.,154.,151.,145.,137.,129.,119./
1620 DATA(Q4T3(K1),K1=1,8)/47.5,47.5,47.6,47.1,45.3,43.3,41.4,39.5/
1630 DATA(V5T3(K1),K1=1,7)/159.,156.,153.,148.,141.,133.,122./
1640 DATA(Q5T3(K1),K1=1,7)/47.6,47.6,47.6,47.1,45.3,43.3,41.4/
1650 DATA(V6T3(K1),K1=1,6)/157.,154.,151.,145.,136.,126./
1660 DATA(Q6T3(K1),K1=1,6)/47.5,47.5,47.5,47.2,45.3,43.3/
1670 DATA(V7T3(K1),K1=1,5)/156.,152.,147.,140.,130./
1680 DATA(Q7T3(K1),K1=1,5)/47.6,47.6,47.6,47.1,45.3/
1690 DATA(V8T3(K1),K1=1,4)/154.,149.,142.,134./
1700 DATA(Q8T3(K1),K1=1,4)/47.5,47.5,47.5,47.2/
1701   DATA PI/3.1415926535/
1702   DATA DTR/0.0174532925/
1703   DATA CHORD/2.25/
1704   DATA BLADES/2./
1705   DATA RADIUS/22./
1706   DATA ROTSPD/5.4/
1707   DATA DRAG/0.0083/
1708   DATA PWREFF/0.85/
1709   DATA TILT/0.0/
1710 T = 15. - 2.*A/1000.
1720 D=TEMP-T
1730 B=-(D+25.)*D*(D-10.)*(D-30.)*(D-40.)/15./40./50./70./80.
1740 B=B*3.28571
1750 B=B+(D+40.)*D*(D-10.)*(D-30.)*(D-40.)/15./25./35./55./65.*2.
1760 B=B-(D+40.)*(D+25.)*D*(D-30.)*(D-40.)/50./35./10./20./30.
1770 B=B+(D+40.)*(D+25.)*D*(D-10.)*(D-40.)/10./55./30./20./10.*2.71429
1780 DELP=B-(D+40.)*(D+25.)*D*(D-10.)*(D-30.)/80./65./40./30./10.*3.571
1790 A = A + 1000.*DELP
1800 T = TEMP*9./5.+492.
1810 WT = 1  + (HELOGW - 6000) /500
1820 TABLE = (THROST-1 )*8  + WT
1830 GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
1840+21,22,23,24,25,26,27,28,29,30,31,32),TABLE
1850 1 CALL CONFRA(11,HEIGHT,V1T1,A,V)
1860 CALL CONFRA(11,HEIGHT,Q1T1,A,Q)
1870 GO TO 199
1880 2 CALL CONFRA(10,HEIGHT,V2T1,A,V)
1890 CALL CONFRA(10,HEIGHT,Q2T1,A,Q)
1900 GO TO 199
1910 3 CALL CONFRA( 9,HEIGHT,V3T1,A,V)
1920 CALL CONFRA( 9,HEIGHT,Q3T1,A,Q)
1930 GO TO 199
1940 4 CALL CONFRA( 8,HEIGHT,V4T1,A,V)
1950 CALL CONFRA(8,HEIGHT,Q4T1,A,Q)
1960 GO TO 199
1970 5 CALL CONFRA( 7,HEIGHT,V5T1,A,V)
1980 CALL CONFRA(7,HEIGHT,Q5T1,A,Q)
1990 GO TO 199
2000 6 CALL CONFRA( 6,HEIGHT,V6T1,A,V)
2010 CALL CONFRA( 6,HEIGHT,Q6T1,A,Q)
2020 GO TO 199
2030 7 CALL CONFRA( 5,HEIGHT,V7T1,A,V)
2040 CALL CONFRA( 5,HEIGHT,Q7T1,A,Q)
2050 GO TO 199
2060 8 CALL CONFRA( 4,HEIGHT,V8T1,A,V)
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2070 CALL CØNFRA( 4,HEIGHT,Q8T1,A,Q)
2080 GØ TØ 199
2090 9 CALL CØNFRA(11,HEIGHT,V1T2,A,V)
2100 CALL CØNFRA(11,HEIGHT,Q1T2,A,Q)
2110 GØ TØ 199
2120 10 CALL CØNFRA(10,HEIGHT,V2T2,A,V)
2130 CALL CØNFRA(10,HEIGHT,Q2T2,A,Q)
2140 GØ TØ 199
2150 11 CALL CØNFRA( 9,HEIGHT,V3T2,A,V)
2160 CALL CØNFRA( 9,HEIGHT,Q3T2,A,Q)
2170 GØ TØ 199
2180 12 CALL CØNFRA( 8,HEIGHT,V4T2,A,V)
2190 CALL CØNFRA( 8,HEIGHT,Q4T2,A,Q)
2200 GØ TØ 199
2210 13 CALL CØNFRA( 7,HEIGHT,V5T2,A,V)
2220 CALL CØNFRA(7,HEIGHT,Q5T2,A,Q)
2230 GØ TØ 199
2240 14 CALL CØNFRA( 6,HEIGHT,V6T2,A,V)
2250 CALL CØNFRA( 6,HEIGHT,Q6T2,A,Q)
2260 GØ TØ 199
2270 15 CALL CØNFRA( 5,HEIGHT,V7T2,A,V)
2280 CALL CØNFRA( 5,HEIGHT,Q7T2,A,Q)
2290 GØ TØ 199
2300 16 CALL CØNFRA( 4,HEIGHT,V8T2,A,V)
2310 CALL CØNFRA( 4,HEIGHT,Q8T2,A,Q)
2320 GØ TØ 199
2330 17 CALL CØNFRA(11,HEIGHT,V1T3,A,V)
2340 CALL CØNFRA(11,HEIGHT,Q1T3,A,Q)
2350 GØ TØ 199
2360 18 CALL CØNFRA(10,HEIGHT,V2T3,A,V)
2370 CALL CØNFRA(10,HEIGHT,Q2T3,A,Q)
2380 GØ TØ 199
2390 19 CALL CØNFRA( 9,HEIGHT,V3T3,A,V)
2400 CALL CØNFRA( 9,HEIGHT,Q3T3,A,Q)
2410 GØ TØ 199
2420 20 CALL CØNFRA( 8,HEIGHT,V4T3,A,V)
2430 CALL CØNFRA(8,HEIGHT,Q4T3,A,Q)
2440 GØ TØ 199
2450 21 CALL CØNFRA( 7,HEIGHT,V5T3,A,V)
2460 CALL CØNFRA(7,HEIGHT,Q5T3,A,Q)
2470 GØ TØ 199
2480 22 CALL CØNFRA( 6,HEIGHT,V6T3,A,V)
2490 CALL CØNFRA( 6,HEIGHT,Q6T3,A,Q)
2500 GØ TØ 199
2510 23 CALL CØNFRA( 5,HEIGHT,V7T3,A,V)
2520 CALL CØNFRA( 5,HEIGHT,Q7T3,A,Q)
2530 GØ TØ 199
2540 24 CALL CØNFRA( 4,HEIGHT,V8T3,A,V)
2550 CALL CØNFRA( 4,HEIGHT,Q8T3,A,Q)
2560 GØ TØ 199
2570 25 CALL CØNFRA(13,HEIGHT,V1T4,A,V)
2580 CALL CØNFRA(13,HEIGHT,Q1T4,A,Q)
2590 GØ TØ 199
2600 26 CALL CØNFRA(12,HEIGHT,V2T4,A,V)
2610 CALL CØNFRA(12,HEIGHT,Q2T4,A,Q)
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```
2620 G0 T0 199
2630 27 CALL CONFRA(11,HEIGHT,V3T4,A,V)
2640 CALL CONFRA(11,HEIGHT,Q3T4,A,Q)
2650 G0 T0 199
2660 28 CALL CONFRA(10,HEIGHT,V4T4,A,V)
2670 CALL CONFRA(10,HEIGHT,Q4T4,A,Q)
2680 G0 T0 199
2690 29 CALL CONFRA(9,HEIGHT,V5T4,A,V)
2700 CALL CONFRA(9,HEIGHT,Q5T4,A,Q)
2710 G0 T0 199
2720 30 CALL CONFRA(8,HEIGHT,V6T4,A,V)
2730 CALL CONFRA(8,HEIGHT,Q6T4,A,0)
2740 G0 T0 199
2750 31 CALL CONFRA(8,HEIGHT,V7T4,A,V)
2760 CALL CONFRA(8,HEIGHT,Q7T4,A,0)
2770 G0 T0 199
2780 32 CALL CONFRA(7,HEIGHT,V8T4,A,V)
2790 CALL CONFRA(7,HEIGHT,Q8T4,A,Q)
2800 199 CONTINUE
2810 A = A - 1000.*DELP
2820 0TP = Q
2830 TC= 5./9.*(T-492.)
2840 S=23.1*0TP
2850 CALL CONFRA(10,VEL,PITCH,V,BETA)
2860    ALPHA = (BETA - TILT)*DTR
2870 VO=V*1.67
2880 HEL = HEL0GW
2882 CALL CONFRA(5,AO,TO,A,T1)
2884 CALL CONFRA(5,AO,D1,A,D)
2886 CALL CONFRA(5,AO,L1,A,L)
2890    SIGMAE = CHORD*BLADES/(PI*RADIUS)
2892    SPDRT0 = VO*COS(ALPHA)/(2.*PI*ROTSPD*RADIUS)
2894    PWREQ = PI**4*D*ROTSPD**3*RADIUS**5*DRAG
2896    PWREQ = PWREQ*SIGMAE*(1.+SPDRT0**2)
2898    PWRAVL = PWREFF*550.*S
2900    VIN = (PWRAVL - PWREQ)*COS(ALPHA)/HEL + VO*SIN(ALPHA)
2910 IF (VIN.LT.0.) VIN=.01
2920 CALL CONFRA(5,SO,W1,S,W9(1))
2930 CALL CONFRA(5,SO,W2,S,W9(2))
2940 CALL CONFRA(5,SO,W3,S,W9(3))
2950 CALL CONFRA(5,SO,W4,S,W9(4))
2960 CALL CONFRA(5,SO,W5,S,W9(5))
2970 CALL CONFRA(5,SO,U1,S,U9(1))
2980 CALL CONFRA(5,SO,U2,S,U9(2))
2990 CALL CONFRA(5,SO,U3,S,U9(3))
3000 CALL CONFRA(5,SO,U4,S,U9(4))
3010 CALL CONFRA(5,SO,U5,S,U9(5))
3020 CALL CONFRA(5,SO,F1,S,F9)
3030 CALL CONFRA(5,AO,W9,A,W8)
3040 CALL CONFRA(5,AO,U9,A,U8)
3050 F8=F9
3090 D2=D*T1/T
3100 M1=T1/519.
3110 M2=SQRT(M1)
3120 CALL CONFRA(9,T2,C1,T1,C4)
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3130 CALL CØNFRA(9,T2,C2,T1,C5)
3140 CALL CØNFRA(9,T2,C3,T1,C6)
3150 CALL CØNFRA(9,T2,C1,T,C7)
3160 CALL CØNFRA(9,T2,C2,T,C8)
3170 CALL CØNFRA(9,T2,C3,T,C9)
3180 R3=S/(L*M2)
3190 CALL CØNFRA(6,R1,R2,R3,R4)
3200 R5=R4*T/519.
3210 W6 = W8*(1.+(C7-C4)/(1.+C4))
3220 U6 = U8*(1.+(C8-C5)/(1.+C5))
3230 F5=F8-(W8*VO)/G
3240 F6 = F5+(L*C9-W8*(1.+C7)*VO/G)-(L*C6-W8*(1.+C4)*VO/G)
3250 Q1=1.+U6/(W6*3600.)
3260 V7=(G*F6/W6+2.*VO)/Q1
3270 T7 = R5-V7**2/(2.*G*H*E)
3280 A7=(W6*T7*Q1)/(G*D2*T*V7)
3290 D7=24.*SQRT(A7/3.1416)
3300 PRINT 222, A, T, THRØST,HELØGW
3305 222 FØRMAT(//*ALTITUDE(FT) = *,F12.4/
3310+* AMBIENT TEMPERATURE (R) = *,F12.4/
3315+* THRØTTLE SETTING = *,I4/
3320+* GRØSS WEIGHT (LBS) = *,I10)
3330 PRINT 225, V, S, V7, T7, D7, Q1, BETA, VIN
3332 225 FØRMAT(//* VELØCITY (KNØTS) IAS = *,F12.4/
3334+* SHP = *,F12.4/
3336+* EXIT VELØSITY (FT/SEC) = *,F12.4/
3338+* EXIT TEMPERATURE (R) = *,F12.4/
3340+* EXIT DIAMETER (INCHES) = *,F12.4/
3342+* 1 + FUEL/AIR RATIØ = *,F12.4/
3344+* HELICØPTER PITCH (DEG) = *,F12.4/
3350+* DØWN WASH VELØSITY (FT/SEC) = *,F12.4)
3355 END
03360*C    PHILLIPS INTERPØLATIØN RUTINE
03370*C
03380*C
03390 SUBRØUTINE CØNFRA(N,X,Y,XI,YI)
03400 DIMENSIØN X(1),Y(1)
03410 IF(XI.LT.X(1))GØ TØ 100
03420 IF(XI.GT.X(N))GØ TØ 110
03430 DØ 10 I=2,N
03440 II=I
03450 IF(XI.LT.X(I))GØ TØ 20
03460 10 CØNTINUE
03470 20 I2=II+1
03480 I1=II
03490 I0=II-1
03500 NN=N+1
03510 IF(I2.NE.NN)GØ TØ 40
03520 I2=II
03530 I1=II-1
03540 I0=II-2
03550 40 A1=(XI-X(I1))*(XI-X(I2))/((X(I0)-X(I1))*(X(I0)-X(I2)))
03560 A2=(XI-X(I0))*(XI-X(I2))/((X(I1)-X(I0))*(X(I1)-X(I2)))
03570 A3=(XI-X(I0))*(XI-X(I1))/((X(I2)-X(I0))*(X(I2)-X(I1)))
03580 YI=A1*Y(I0)+A2*Y(I1)+A3*Y(I2)
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03590 GØ TØ 1000
03600 100 I2=1
03610 I1=2
03620 I0=3
03630 GØ TØ 120
03640 110 I2=N
03650 I1=N-1
03660 I0=N-2
03670 120 A=(X(I0)-X(I2))
03680 Y2P=(Y(I2)-Y(I1))/(X(I2)-X(I1))
03690 A=A*A
03700 B=(X(I1)-X(I2))
03710 B=B*B
03720 C=X(I0)-X(I1)
03730 DEN=A*B*C
03740 D1=(Y(I0)-Y2P*(X(I0)-X(I2))-Y(I2))*B
03750 D2=(Y(I1)-Y2P*(X(I1)-X(I2))-Y(I2))*A
03760 AA=(D1-D2)/DEN
03770 D1=D1*B
03780 D2=D2*A
03790 BB=(D2-D1)/DEN
03800 A=XI-X(I2)
03810 A=A*A*A
03820 B=XI-X(I2)
03830 B=B*B
03840 YI=AA*A+BB*B+Y2P*(XI-X(I2))+Y(I2)
03850 1000 GØ TØ 1500
03860*C  TØ PRINT ØUT INTERPØLATIØNS CHANGE STATMENT 1000 TØ CØNTINUE
03870 PRINT 1010,XI,YI
03880 PRINT 1020,(X(I),I=1,N)
03890 PRINT 1020,(Y(I),I=1,N)
03900 1010 FØRMAT(//*X=*F10.4,*Y=*F10.4)
03910 1020 FØRMAT(9F8.3)
03920 1500 CØNTINUE
03930 RETURN
03940 END

LENGTH =  421 LINES
```

B-9

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APPENDIX   C   (U)

SELECTED DATA

FROM THE

AH – 1G

OPERATOR's MANUAL

RANGE CHART
STANDARD DAY
ENGINE SPEED 6600 RPM

LONG RANGE - CRUISE SPEED

Model(s): **AH-1G**
Data as of: NOVEMBER 1966
DATA BASIS: Estimated

Engine(s): Lycoming T53-L-13
Fuel Grade: JP-4
Fuel Density: 6.5 LB/GAL.

GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS			GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS		
		TORQUE PRESS	APPROXIMATE				TORQUE PRESS	APPROXIMATE	
			FUEL FLOW	SPEED/KNTS				FUEL FLOW	SPEED/KNTS
POUNDS	FEET	PSIG	LB/HR	IAS	POUNDS	FEET	PSIG	LB/HR	IAS
6000	0	41.1	664	153	7500	0	41.4	666	152
	2000	37.3	606	146		2000	39.3	625	147
	4000	35.2	567	141		4000	35.8	573	139
	6000	33.1	529	136		6000	32.5	524	131
	8000	30.4	489	129		8000	31.5	500	125
	10000	28.0	450	123		10000	31.3	483	121
	12000	26.9	426	119		12000	30.6	463	113
	14000	25.9	4?2	114	7500	14000	32.3	467	108
	16000	24.6	3?8	108	8000	0	41.5	667	151
	18000	24.5	367	103		2000	39.5	627	146
6000	20000	24.8	3?0	97		4000	36.0	575	137
						6000	34.3	541	131
6500	0	41.2	665	153		8000	32.8	512	124
	2000	37.4	607	146		10000	32.1	491	116
	4000	35.4	569	141	8000	12000	34.0	497	111
	6000	33.3	532	135					
	8000	30.7	492	129	8500	0	41.5	568	150
	10000	28.4	454	122		2000	37.9	612	141
	12000	27.3	430	117		4000	37.9	592	138
	14000	27.0	414	113		6000	35.7	555	129
	16000	26.3	395	106		8000	34.9	534	121
6500	18000	26.9	390	99	8500	10000	36.9	539	116
					9000	0	41.6	668	148
7000	0	41.2	665	153		2000	39.9	631	142
	2000	37.6	609	145		4000	37.9	592	134
	4000	35.6	571	140		6000	37.9	577	127
	6000	33.6	535	134	9000	8000	38.6	569	120
	8000	31.1	495	127					
	10000	30.0	470	122	9500	0	41.8	671	146
	12000	28.5	442	115		2000	41.5	646	141
	14000	27.9	422	108		4000	39.9	613	132
7000	16000	29.5	427	103	9500	6000	41.7	615	126

RANGE CHART
STANDARD DAY
ENGINE SPEED 6600 RPM
LONG RANGE - INTERMEDIATE CRUISE SPEED

Model(s): AH-1G
Data as of: NOVEMBER 1966
DATA BASIS: ESTIMATED

Engine(s): Lycoming T53-L-13
Fuel Grade: JP-4
Fuel Density: 6.5 LB/GAL.

GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS			GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS		
		TORQUE PRESS	APPROXIMATE				TORQUE PRESS	APPROXIMATE	
			FUEL FLOW	SPEED/KNTS				FUEL FLOW	SPEED/KNTS
POUNDS	FEET	PSIG	LB/HR	IAS	POUNDS	FEET	PSIG	LB/HR	IAS
6000	0	44.0	692	157	7500	0	41.2	693	156
	2000	41.6	648	152		2000	43.0	661	152
	4000	40.3	616	149		4000	40.9	622	147
	6000	38.7	584	145		6000	38.6	584	141
	8000	36.2	546	139		8000	37.2	556	135
	10000	33.9	509	134		10000	36.5	535	129
	12000	32.7	484	129		12000	35.4	512	121
	14000	31.4	458	124	7500	14000	35.6	502	113
	16000	30.0	432	118	8000	0	44.3	694	155
	18000	29.2	414	111		2000	43.1	663	151
6000	20000	27.4	386	101		4000	41.1	624	145
6500	0	44.1	692	157		6000	39.8	595	140
	2000	41.7	649	152		8000	38.2	566	132
	4000	40.5	616	148		10000	37.1	541	124
	6000	38.9	586	144	8000	12000	37.4	533	117
	8000	36.6	550	138	8500	0	44.3	694	154
	10000	34.4	515	132		2000	42.2	653	148
	12000	33.0	488	127		4000	42.2	635	144
	14000	32.3	467	122		6000	40.8	605	137
	16000	31.1	444	114		8000	39.6	580	129
6500	18000	30.8	431	106	8500	10000	39.9	569	121
7000	0	44.1	692	156	9000	0	44.4	695	152
	2000	41.9	650	152		2000	43.4	665	147
	4000	40.6	619	148		4000	42.2	635	140
	6000	39.2	590	143		6000	42.1	619	134
	8000	37.0	554	137	9000	8000	41.7	601	125
	10000	35.5	525	132	9500	0	44.5	696	150
	12000	34.0	497	124		2000	44.3	674	145
	14000	32.9	473	117		4000	43.4	648	137
7000	16000	33.2	465	110	9500	6000	44.3	641	130

RANGE CHART
STANDARD DAY
ENGINE SPEED 6600 RPM
LONG RANGE - MAXIMUM SPEED

Model(s):   AH-1G
Data as of: NOVEMBER 1966
DATA BASIS: ESTIMATED

Engine(s):Lycoming T53-L-13
Fuel Grade: JP-4
Fuel Density: 6.5 LB/GAL.

GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS			GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS		
		TORQUE PRESS	APPROXIMATE				TORQUE PRESS	APPROXIMATE	
			FUEL FLOW	SPEED/KNTS				FUEL FLOW	SPEED/KNTS
POUNDS	FEET	PSIG	LB/HR	IAS	POUNDS	FEET	PSIG	LB/HR	IAS
6000	0	47.5	726	161	7500	0	47.5	726	160
	2000	47.5	707	159		2000	47.5	707	157
	4000	47.5	690	156		4000	47.6	690	154
	6000	47.1	670	153		6000	47.1	670	151
	8000	45.2	637	149		8000	45.3	637	145
	10000	43.3	604	144		10000	43.3	604	137
	12000	41.4	575	139		12000	41.4	575	129
	14000	39.5	544	134	7500	14000	39.5	543	119
	16000	37.6	513	127					
	18000	35.4	481	120	8000	0	47.6	726	159
6000	20000	30.4	417	106		2000	47.6	707	156
						4000	47.6	690	153
6500	0	47.5	726	161		6000	47.1	670	148
	2000	47.5	707	159		8000	45.3	637	141
	4000	47.6	690	156		10000	43.3	604	133
	6000	47.1	670	153	8000	12000	41.4	575	122
	8000	45.3	637	148	8500	0	47.5	726	157
	10000	43.4	604	143		2000	47.5	707	154
	12000	41.4	574	138		4000	47.5	689	151
	14000	39.5	544	130		6000	47.2	670	145
	16000	37.5	513	123		8000	45.3	637	136
6500	18000	35.6	483	113	8500	10000	43.3	604	126
7000	0	47.5	726	160	9000	0	47.6	726	156
	2000	47.5	707	158		2000	47.6	707	152
	4000	47.5	690	155		4000	47.6	690	147
	6000	47.2	670	152		6000	47.1	670	140
	8000	45.3	637	147	9000	8000	45.3	637	130
	10000	43.3	604	141	9500	0	47.5	726	154
	12000	41.4	574	134		2000	47.5	707	149
	14000	39.5	544	126		4000	47.5	690	142
7000	16000	37.5	513	116	9500	6000	47.2	671	134

MAXIMUM ENDURANCE
STANDARD DAY
ENGINE SPEED 6600 RPM

Model(s): AH-1G
Data as of: JULY 1966
DATA BASIS: ESTIMATED

Engine(s): Lycoming T53-L-13
Fuel Grade: JP-4
Fuel Density: 6.5 LB/GAL.

GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS			GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS		
		TORQUE PRESS	APPROXIMATE				TORQUE PRESS	APPROXIMATE	
			FUEL FLOW	SPEED/KNOTS				FUEL FLOW	SPEED/KNOTS
POUNDS	FEET	PSIG	LB/HR	IAS	POUNDS	FEET	PSIG	LB/HR	IAS
6000	0	16.3	437	55	7000	0	17.5	448	59
	2000	15.8	406	55		2000	17.1	418	60
	4000	15.3	379	55		4000	16.7	392	60
	6000	14.9	356	55		6000	16.5	370	60
	8000	14.5	336	55		8000	16.3	353	60
	10000	14.2	318	56		10000	16.3	337	60
	12000	14.0	303	56		12000	16.6	326	59
	14000	14.0	289	56		14000	17.2	319	58
	16000	14.1	278	55		16000	18.4	318	57
	18000	14.5	271	55		18000	20.5	328	55
	20000	15.4	269	54	7000	20000	24.0	351	51
	22000	17.0	277	52	7500	0	18.3	455	62
6000	24000	19.7	297	48		2000	17.9	426	62
6500	0	16.9	443	57		4000	17.6	400	62
	2000	16.4	412	57		6000	17.4	380	62
	4000	16.0	385	57		8000	17.5	364	62
	6000	15.6	362	58		10000	17.8	351	61
	8000	15.3	344	58		12000	18.5	344	60
	10000	15.1	327	58		14000	19.8	343	59
	12000	15.1	313	58		16000	22.1	353	56
	14000	15.3	301	57	7500	18000	25.8	379	52
	16000	15.9	294	56					
	18000	16.9	294	55					
	20000	18.8	301	53					
6500	22000	21.9	325	49					

C-5

Ⓦ

MAXIMUM ENDURANCE
STANDARD DAY
ENGINE SPEED 6600 RPM

Model(s): AH-1G
Data as of: JULY 1966
DATA BASIS: ESTIMATED

Engine(s): Lycoming T53-L-13
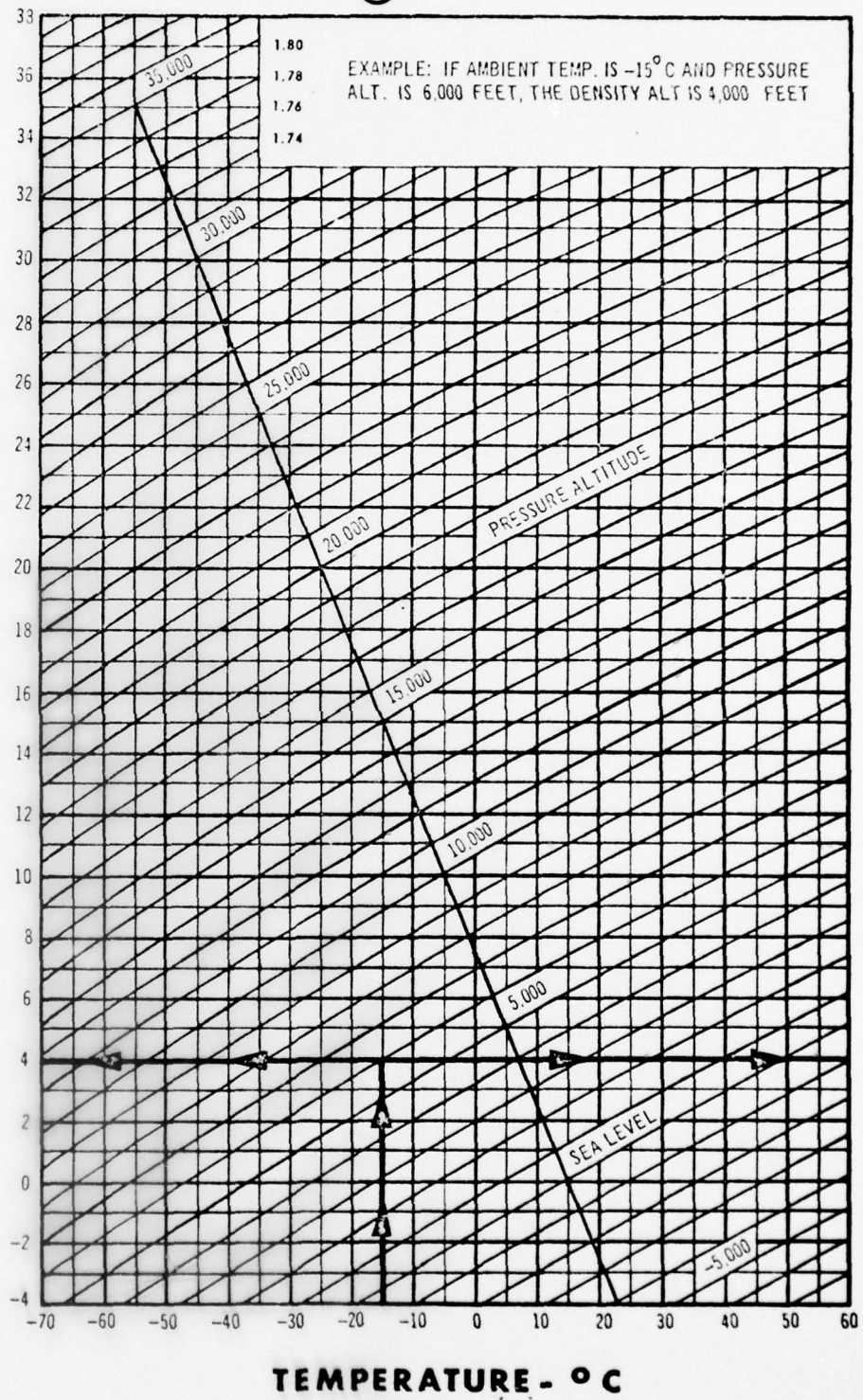Fuel Grade: JP-4
Fuel Density: 6.5 LB/GAL.

GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS			GROSS WEIGHT	PRESS. ALT.	POWER SETTINGS		
		TORQUE PRESS	APPROXIMATE				TORQUE PRESS	APPROXIMATE	
			FUEL FLOW	SPEED/KNOTS				FUEL FLOW	SPEED/KNOTS
POUNDS	FEET	PSIG	LB/HR	IAS	POUNDS	FEET	PSIG	LB/HR	IAS
8000	0	19.0	462	64	9000	0	20.9	479	67
	2000	18.8	433	64		2000	21.0	454	67
	4000	18.6	410	64		4000	21.3	435	67
	6000	18.7	391	64		6000	22.1	424	66
	8000	19.0	378	63		8000	23.5	422	64
	10000	19.8	370	62		10000	26.0	430	61
	12000	21.2	370	60		12000	29.3	455	57
	14000	23.5	379	58	9000	14000	35.9	505	52
8000	16000	27.4	405	54					
					9500	0	22.1	489	69
8500	0	19.9	470	66		2000	22.5	468	68
	2000	19.8	443	66		4000	23.2	453	67
	4000	19.8	427	66		6000	24.6	448	66
	6000	20.2	405	65		8000	27.0	455	63
	8000	21.0	397	64		10000	30.8	478	60
	10000	22.4	395	62	9500	12000	36.7	526	54
	12000	24.8	405	59					
8500	14000	28.7	431	56					

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APPENDIX   D (U)

SELECTED DATA FROM

LYCOMING

ON THE

T53-L-13   TURBINE
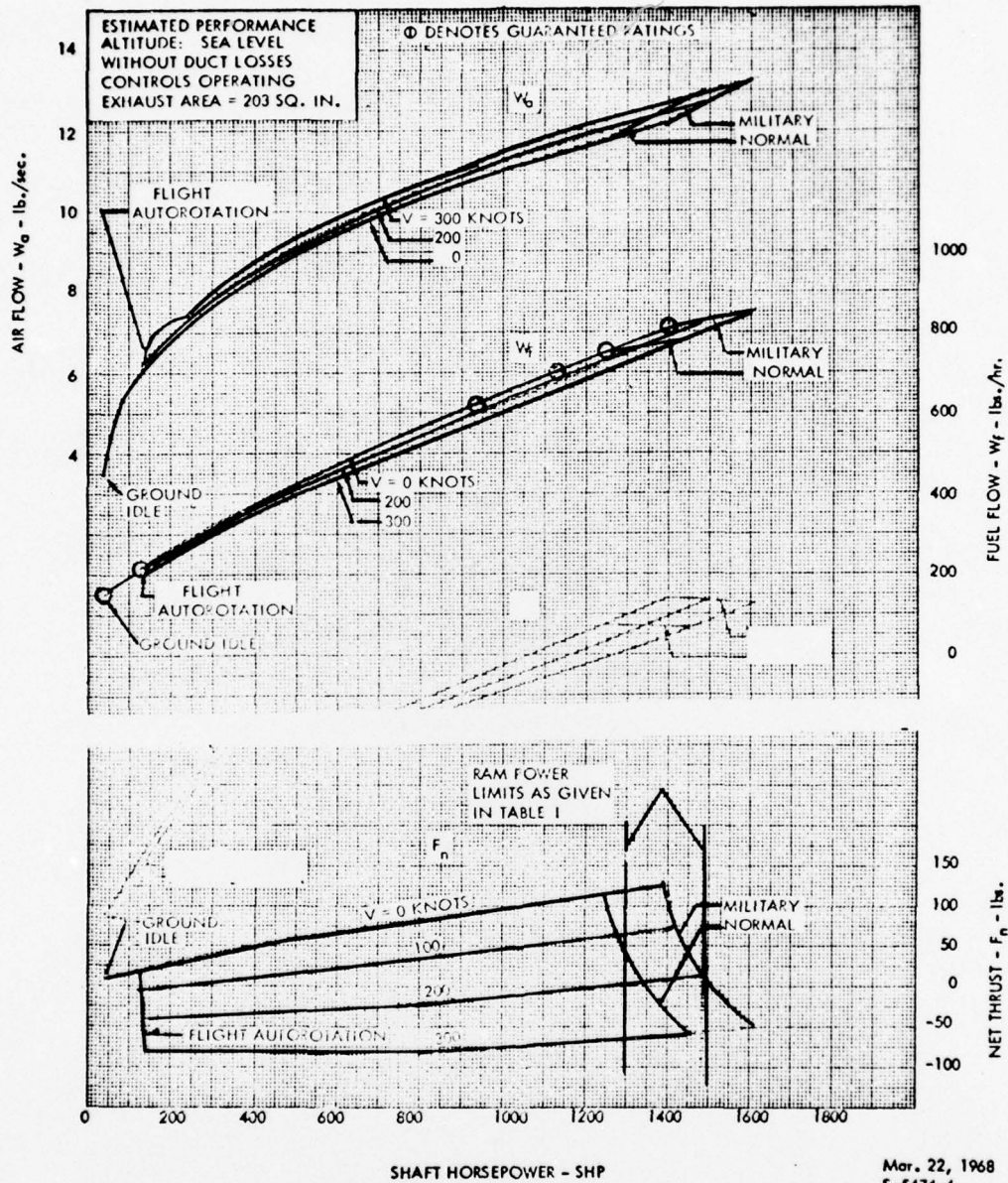
ESTIMATED PERFORMANCE
ALTITUDE: SEA LEVEL
WITHOUT DUCT LOSSES
CONTROLS OPERATING
EXHAUST AREA = 203 SQ. IN.

Mar. 22, 1968
S-5474-4
Figure 1.1

(Rev. 30 September 1969)

LYCOMING MODEL SPECIFICATION

SPEC. NO 104.33
ENGINE MODEL: T53-L-13

D-2

ESTIMATED PERFORMANCE
ALTITUDE: 5,000 FEET
WITHOUT DUCT LOSSES
CONTROLS OPERATING
EXHAUST AREA = 203 SQ. IN.

SHAFT HORSEPOWER - SHP
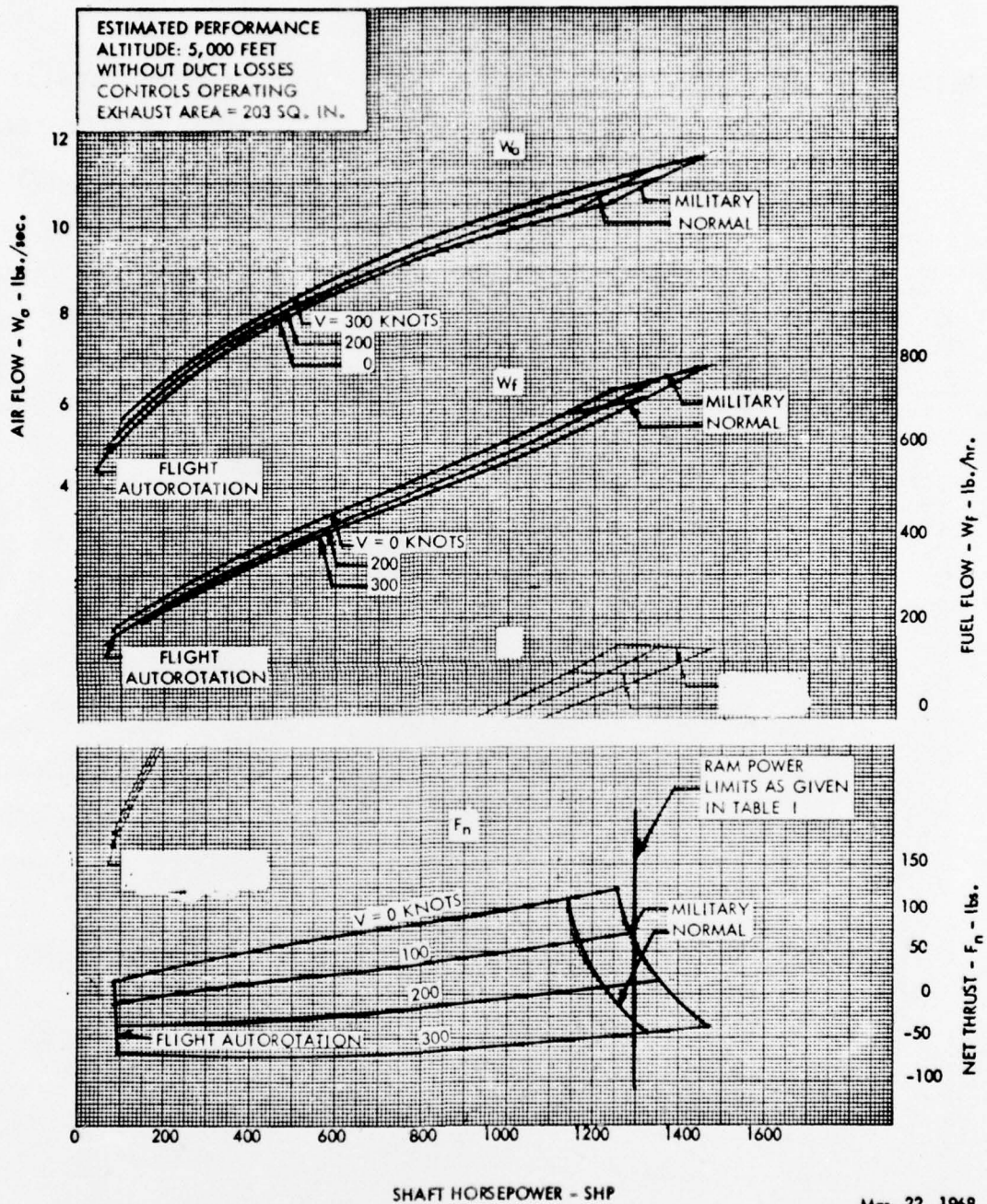
Mar. 22, 1968
S-5475-4
Figure 1.2

(Rev. 30 September 1969)

LYCOMING MODEL SPECIFICATION
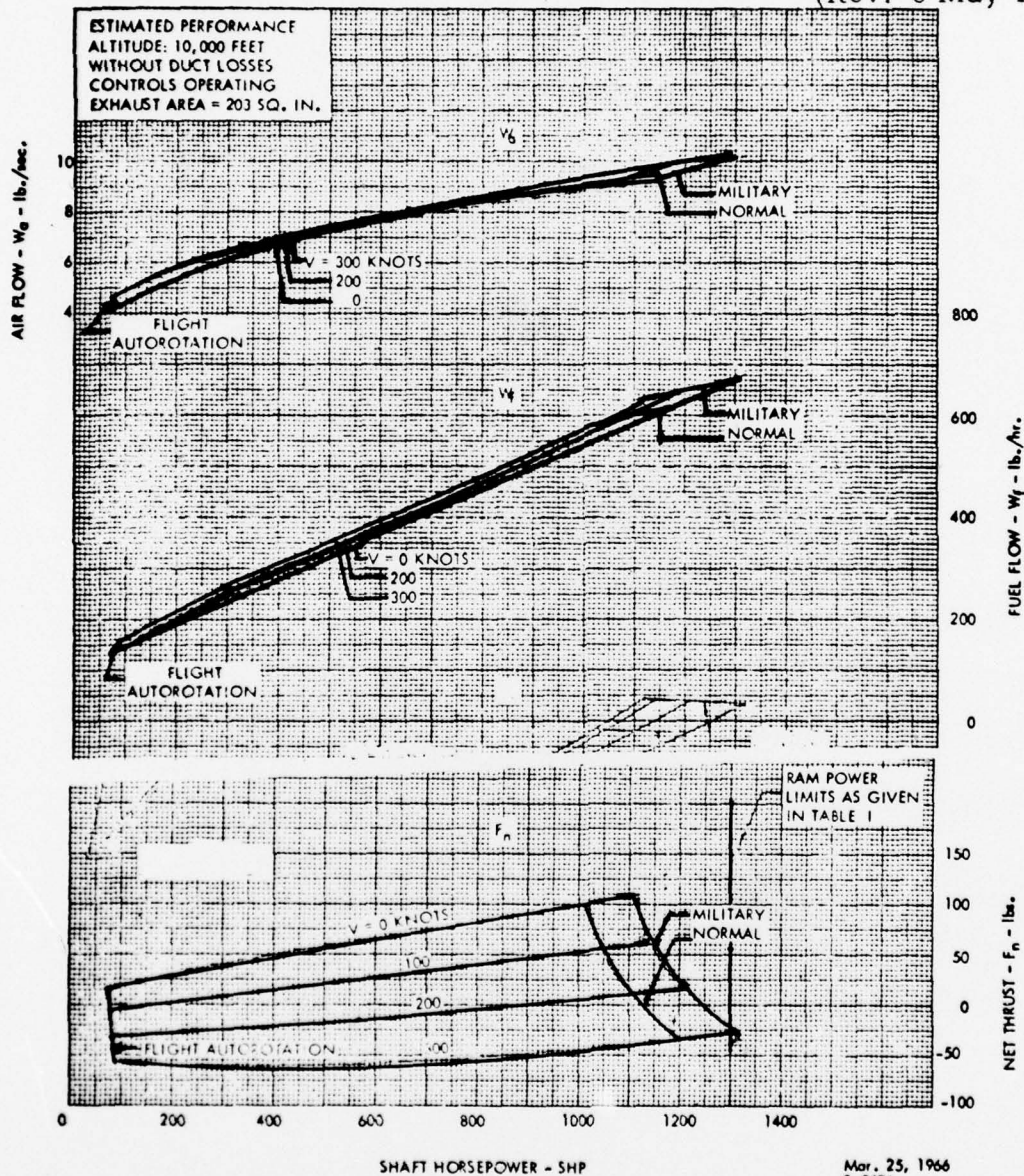
SPEC. NO   104.33
ENGINE MODEL: T53-L-13

D-3

LYCOMING MODEL SPECIFICATION
T53-L-13 ENGINE

SPEC. NO. 104.33

DATE: 30 SEPT. 1964

(Rev. 6 May 1966) .

ESTIMATED PERFORMANCE
ALTITUDE: 10,000 FEET
WITHOUT DUCT LOSSES
CONTROLS OPERATING
EXHAUST AREA = 203 SQ. IN.

AIR FLOW - W_a - lbs./sec.

V_6

MILITARY
NORMAL

V = 300 KNOTS
200
0

FLIGHT
AUTOROTATION

W_f

MILITARY
NORMAL

V = 0 KNOTS
200
300

FLIGHT
AUTOROTATION

FUEL FLOW - W_f - lbs./hr.

RAM POWER
LIMITS AS GIVEN
IN TABLE I

F_n

V = 0 KNOTS

MILITARY
NORMAL

100

200

FLIGHT AUTOROTATION

300

NET THRUST - F_n - lbs.

SHAFT HORSEPOWER - SHP

Mar. 25, 1966
S-5476
Figure 1.3

LYCOMING MODEL SPECIFICATION
T53-L-13 ENGINE

SPEC. NO. 104.33

DATE: 30 SEPT. 1964

(Rev. 6 May 1966)

ESTIMATED PERFORMANCE
ALTITUDE: 15,000 FEET
WITHOUT DUCT LOSSES
CONTROLS OPERATING
EXHAUST AREA = 203 SQ.IN.

SHAFT HORSEPOWER - SHP
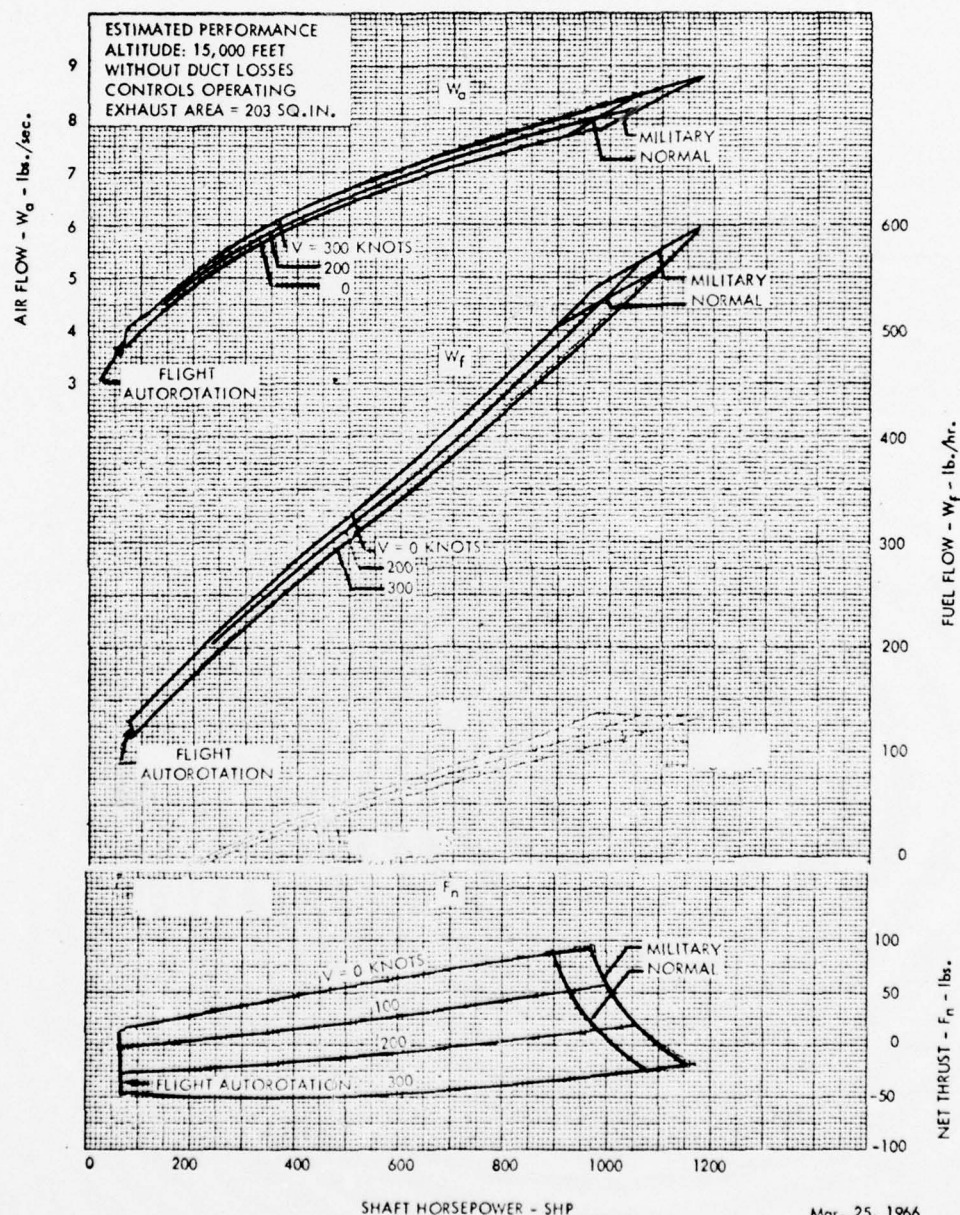
Mar. 25, 1966
S-5477
Figure 1.4

D-5

LYCOMING MODEL SPECIFICATION
T53-L-13 ENGINE

SPEC. NO. 104.33

DATE: 30 SEPT. 1964

(Rev. 6 May 1966)

ESTIMATED PERFORMANCE
ALTITUDE: 20,000 FEET
WITHOUT DUCT LOSSES
CONTROLS OPERATING
EXHAUST AREA = 203 SQ. IN.
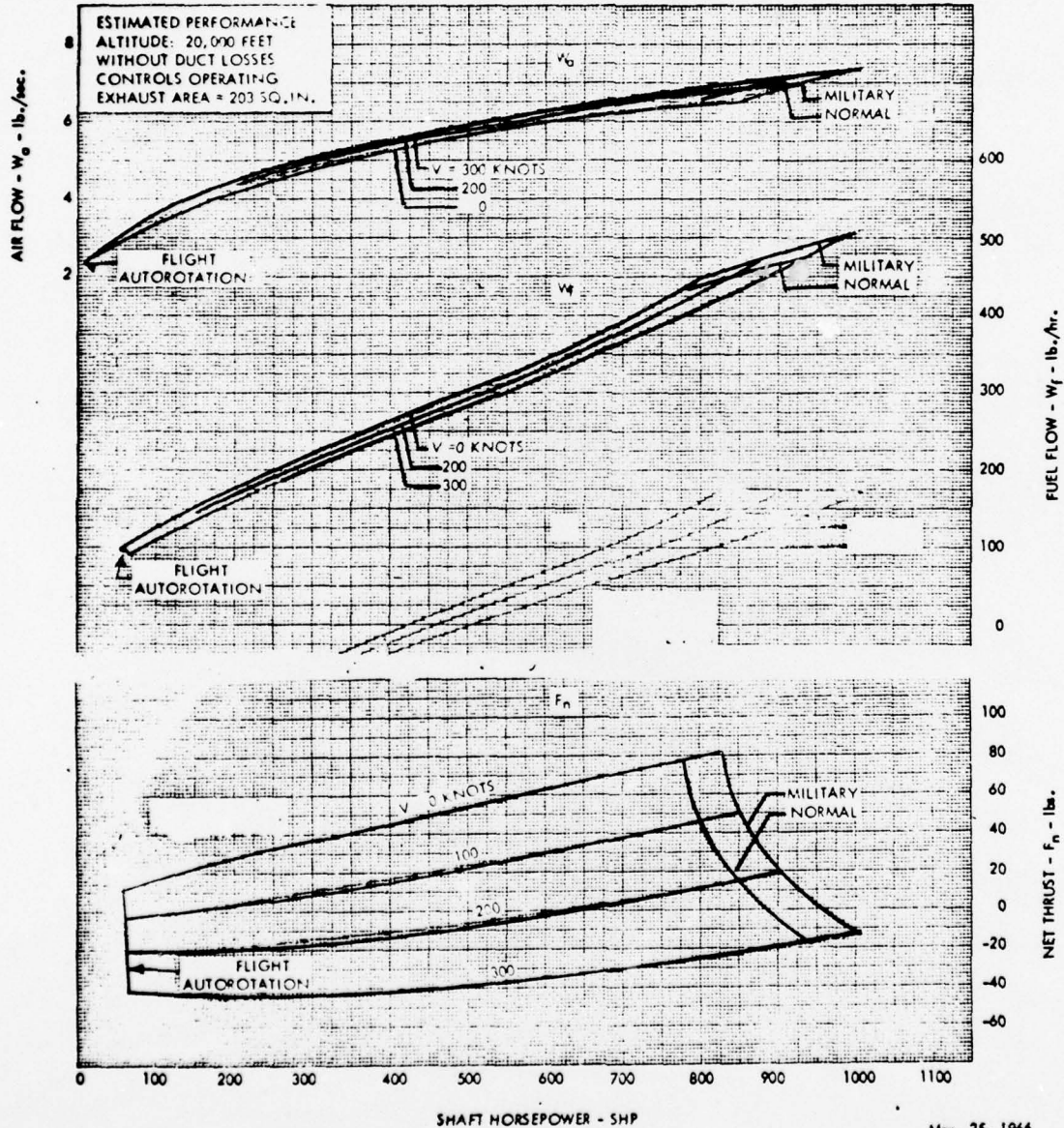
Mar. 25, 1966
S-5478
Figure 1.5

D-6

LYCOMING MODEL SPECIFICATION

REFERRED POWER TURBINE
OUTLET TOTAL TEMPERATURE
T53-L-13 ENGINE

Figure 13.1

D-7

LYCOMING MODEL SPECIFICATION
T53-L-13 ENGINE

SPEC. NO. 104.33

DATE: 30 SEPT. 1964

AMBIENT TEMPERATURE
CORRECTION FACTORS
80% NORMAL RATED POWER
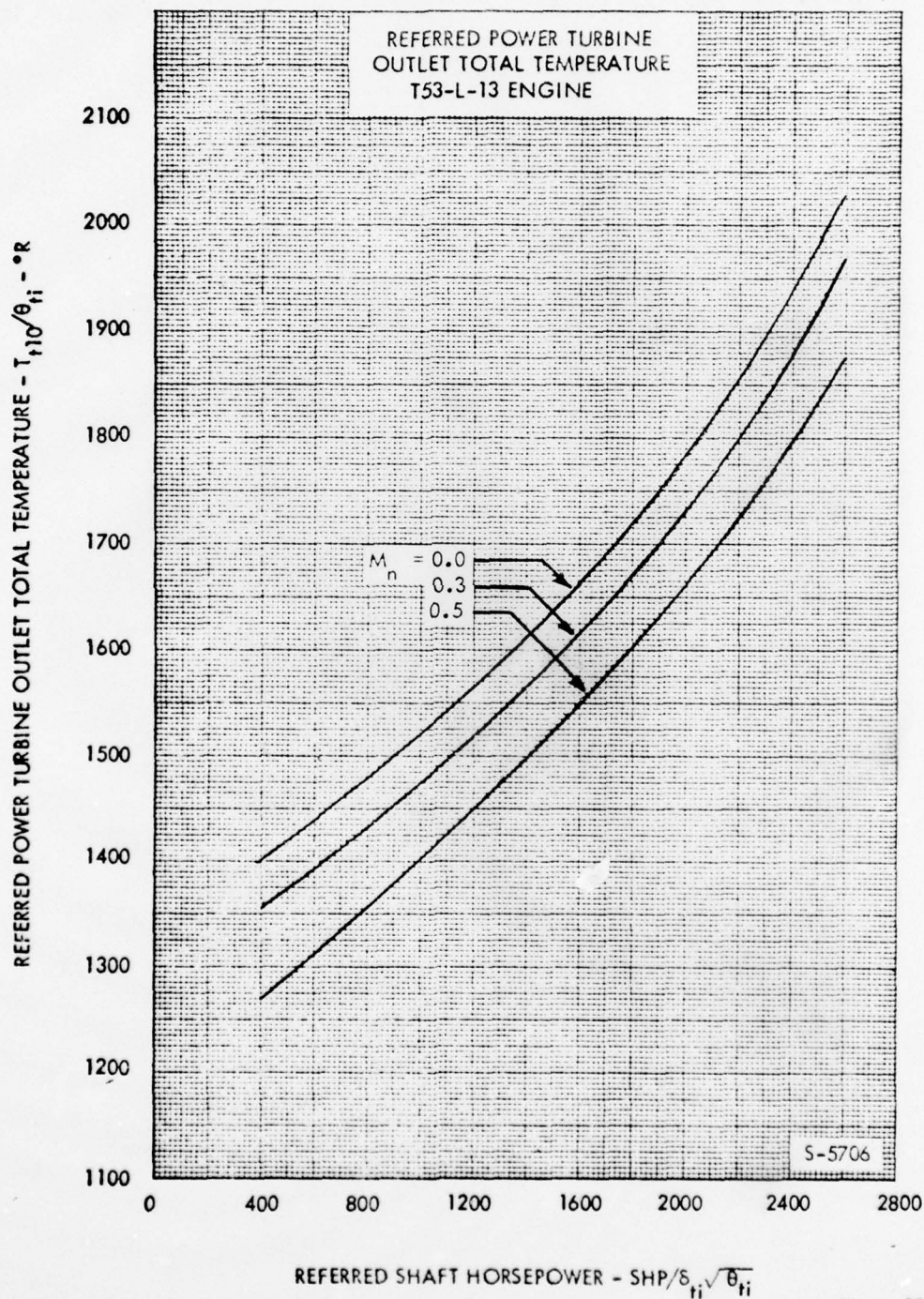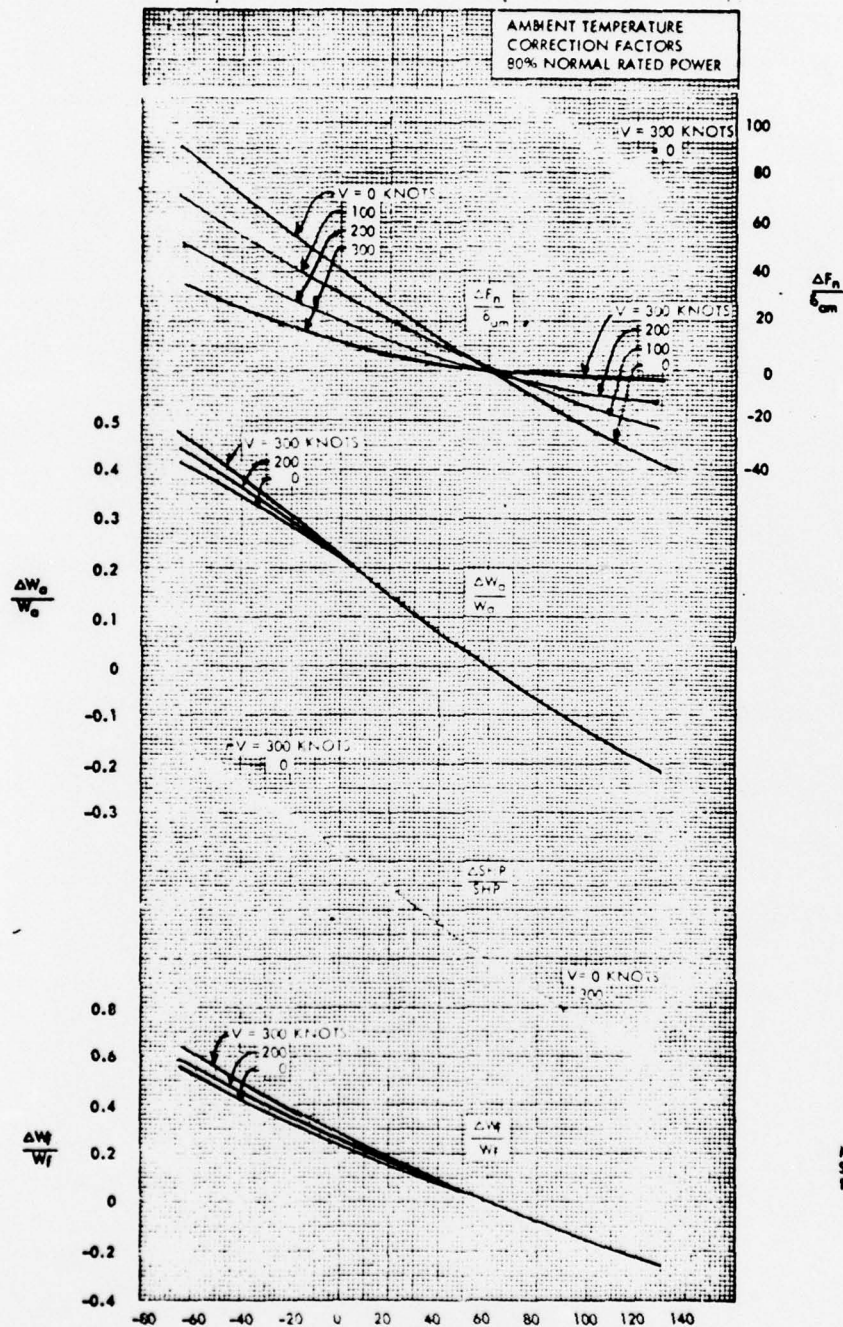
Mar. 25, 1966
S-5483
Figure 2.3

D-8